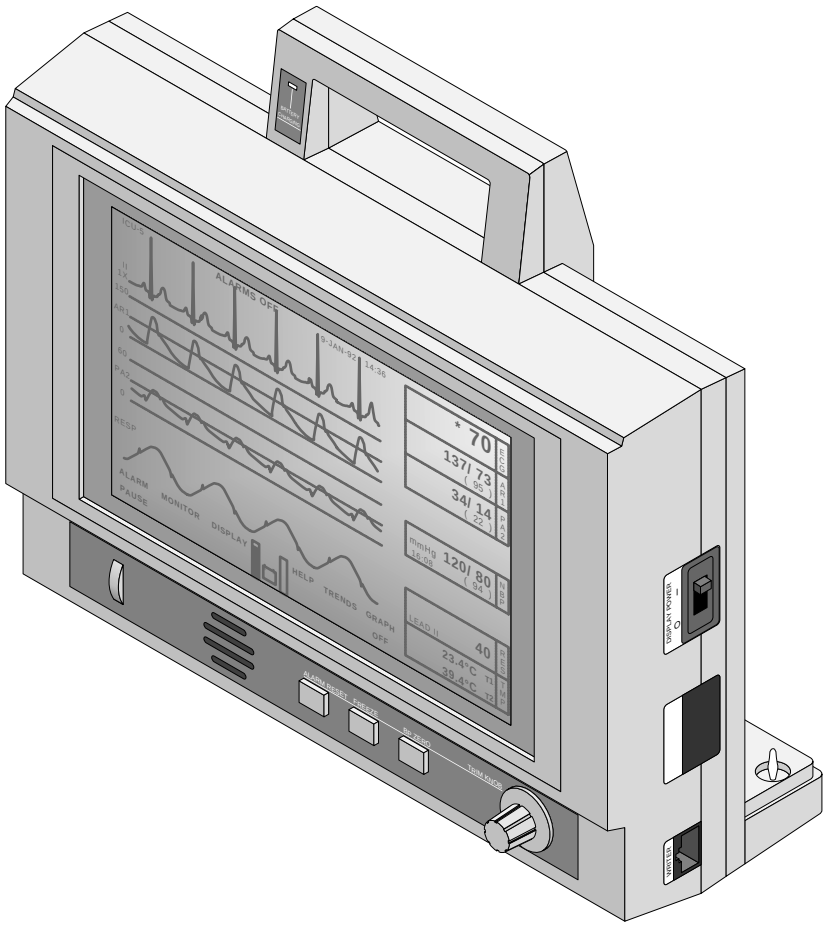
Smart-pac™
Transport Display
Service Manual

403596-036 Revision E



marquette
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NOTE

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Table of Contents

Introduction iii
Manual Information iv
Safety Information vii
Service Information xi
How to Reach Us xii
Abbreviations xiii

General Information 1-1
About the Smart-pac Transport Display 1-2
Caring for Your Smart-pac Battery Pack 1-5
Technical Specifications 1-7

Troubleshooting 2-1
Considerations for Special Components 2-2
Replacing the LCD Display 2-4
Disassembly Procedure 2-5
Problems and Solutions 2-11

Calibration 3-1
Display Processor PCB PN 800814 3-2
Display Processor PCB PN 85638 3-4
Battery Interface PCB PN 403861 3-9

Preventative Maintenance 4-1
Maintenance Schedule 4-2
Inspection 4-3
Cleaning 4-4
Checkout Procedure 4-5

414189/900022 Smart-pac Transport Display 5-1
Parts List (PN 414189-001D) 5-2
Exploded View (PN 414189-001D) 5-3
Parts List (PN 900022-100C) 5-4
Exploded View (PN 900022-100C) 5-5

413780/404706 Tram Transport Display Assembly 6-1
Parts List (PN 413780-001D/002E) 6-2
Exploded View (PN 413780-001D/002E) 6-3
Revisions to the Assemblies 6-5
Parts List (PN 404706-100D) 6-6
Exploded View (PN 404706-100D) 6-7

→ Table of Contents

800814/85638 Display Processor PCB Assembly 7-1
Parts List (PN 800814-001D) 7-2
Parts List (PN 801446-001A) 7-4
Parts Location Diagram (PN 800814-001D) 7-5
Parts Location Diagram (PN 801446-001A) 7-7
Schematic Diagram (SD800814-001B) 7-9
Schematic Diagram (SD 801446-001A) 7-16
Theory of Operation for PN800814 7-17
List of Inputs and Outputs 7-22
Revisions to the Assemblies 7-26
Parts List (PN 85638-006C) 7-27
Parts Location Diagram (PN 85638-006C 7-30
Schematic Diagram (SD85638-006A) 7-32

85639 Switch PCB Assembly 8-1
Parts List (PN 85639-002B) 8-2
Parts Location Diagram (PN 85639-002B) 8-2
Schematic Diagram (PN 85639-002B) 8-2

800138 Cartridge PCB Assembly 9-1
Parts List (PN 800138-001D/002C) 9-2
Parts Location Diagram (PN 800138-001D/002C) 9-3
Schematic Diagram (SD800138-001B) 9-4
Revisions to the Assemblies 9-5

402472 Battery Backpack Assembly 10-1
Parts List (PN 402472-001K) 10-2
Exploded View (PN 402472-001K) 10-3
Interconnection Diagram (402472-001K) 10-4

403191 Contact Plate Assembly 11-1
Parts List (PN 403191-001F) 11-2
Exploded View (PN 403191-001F) 11-2

402708 Contact Plate PCB Assembly 12-1
Parts List (PN 402708-002D) 12-2
Parts Location Diagram (PN 402708-002D) 12-2
Schematic Diagram (PN 402708-002D) 12-2

403861 Battery Interface PCB Assembly 13-1
Parts List (PN 403861-002G) 13-2
Parts Location Diagram (PN 403861-002G) 13-4
Schematic Diagram (PN 403861-003E) 13-5

Introduction

WHAT IS IN THIS CHAPTER?

This introduction contains information to help you use this manual more effectively.

Contents

Manual Information iv
Safety Information viii
Service Information x
How to Reach Us... xi
Abbreviations xiii

Manual Information

Revision History

Each page of this manual has a revision letter, located at the bottom of the page, that identifies its update level. This may be important if you have different updates to a manual and don't know which is the most current.

For the initial release, all pages have the revision letter A. For the first update of the manual all pages receive the revision letter B. The latest letter of the alphabet added corresponds to the most current revision.

At the time of this writing, there are five revisions of this manual:

Revision A	12 March 1993
Revision B	12 March 1994
Revision C	2 August 1995
Revision D	21 June 1996
Revision E	26 November 1997

→ Manual Information

Manual Purpose

This service manual has been prepared by the Technical Publications staff of Marquette Medical Systems, Inc. It is intended for qualified service representatives and technical personnel involved in maintaining and repairing the Smart-pac transport display (hereafter referred to as the transport display).

This manual is geared toward trained biomedical engineers. Users are expected to have a strong background in electronics, including a strong background in analog circuitry, digital circuitry, and microprocessor and microcontroller architecture.

Chapter Contents

Chapter 1: General Information

The manual contains several chapters. The first of these chapters, General Information, gives a description of the transport display, including technical specifications.

Chapter 2: Troubleshooting

Chapter Two, "Troubleshooting," contains information about how to disassemble, repair, and re-assemble the transport display more effectively.

Chapter 3: Calibration

Chapter Three, "Calibration," explains how to adjust the transport display periodically to keep the data that it presents accurate.

Chapter 4: Preventive Maintenance

Chapter Four, "Maintenance," describes how to maintain the transport display and keep it in good working order.

The Remaining Chapters: Mechanical and Electronic Assemblies

Chapters five through thirteen describe the major electronic and mechanical assemblies of the equipment.

- Chapter five describes the Smart-pac Transport Display which consists of the Tram Transport Display and Battery Backpack assemblies. It lists all of the parts that comprise the upper-level assembly and an exploded view.
- Chapter six describes the Smart-pac Transport Display. It lists all of the parts that comprise the assembly and an exploded view.
- Chapters seven through Nine describe the printed circuit board assemblies in Tram Transport Display assembly. These chapters include parts lists, parts location diagrams, and schematic diagrams. Some of them may contain additional details, like theory of operation and a list of inputs and outputs.
- Chapters ten through thirteen describe the Battery Backpack assembly and its related circuits. These chapters list all of the parts that comprise the assemblies and show exploded views to assist you in disassembly, parts replacement, and re-assembly.

➔ Manual Information

Related Manuals

The following is a list of manuals related to the Smart-pac Transport Display.

403596-030 *Smart-pac Charger Service Manual*

This manual includes all data relating to the Smart-pac charger.

403596-033 *Smart-pac Power Supply Service Manual*

This manual includes all data relating to the Smart-pac power supply.

404232-001 *Smart-pac Installation Instructions*

This manual includes all data relating to installing a Smart-pac Transport Display.

404422-065 *Tram 100-850 A and SL Modules Service Manual*

This manual includes data relating to all 100 through 850 A and SL versions of the Tram modules.

404422-108 *Smart-pac Transport Display Operator's Manual*

This manual includes all operating information for the Smart-pac Transport Display using V6 through V10 software.

Safety Information

Manufacturer's Responsibility

Marquette Medical Systems, Inc is responsible for the effects on safety, reliability, and performance only if:

- ✓ assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by Marquette Medical Systems, Inc;
- ✓ the electrical installation of the relevant room complies with the requirements of the appropriate regulations; and
- ✓ the Smart-pac transport display is used in accordance with the instructions for use.

Intended Use

This device is intended for used under the direct supervision of a licensed health care practitioner.

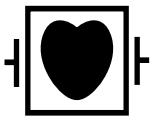
To ensure patient safety, use only parts and accessories manufactured or recommended by Marquette Medical Systems.

Contact Marquette Medical Systems for information before connecting any devices to the equipment that are not recommended in this manual.

Equipment Symbols

The following symbols appear on the equipment.

ATTENTION: Consult accompanying documents before using the equipment.



TYPE CF APPLIED PART: Isolated (floating) connection suitable for intentional external and internal application to the patient including direct cardiac application. “Paddles” outside the box indicate the applied part is defibrillator proof.

Medical Standard Definition: F-type applied part (floating/isolated) complying with the specified requirements of IEC 601-1/UL 2601-1/CSA 601.1 Medical Standards to provide a higher degree of protection against electric shock than that provided by type BF applied parts.

TYPE BF APPLIED PART: Isolated (floating) connection suitable for intentional external and internal application to the patient excluding direct cardiac application. “Paddles” outside the box indicate the applied part is defibrillator proof.

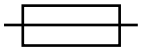
Medical Standard Definition: F-type applied part (floating/isolated) complying with the specified requirements of IEC 601-1/UL 2601-1/CSA 601.1 Medical Standards to provide a higher degree of protection against electric shock than that provided by type B applied parts.

TYPE B APPLIED PART: Non-isolated connection suitable for intentional external and internal application to the patient excluding direct cardiac application.

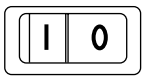
Medical Standard Definition: Applied part complying with the specified requirements of IEC 601-1/UL 2601-1/CSA 601.1 Medical Standards to provide protection against electric shock, particularly regarding allowable leakage current.

Equipotentiality

Alternating current (AC)



Fuses



Power; I = ON; O = OFF

Explosion hazard; Do NOT incinerate battery.

Do NOT directly connect the negative and the positive terminals of the battery.

Recycle internal battery.

➔ Safety Information

Warnings, Cautions, and Notes

Warnings, cautions, and notes are used in this manual to provide additional information to service personnel.

Danger

DANGER

Danger indicates an imminent hazard which, if not avoided, will result in death or serious injury.

Warning

WARNING

Warning indicates a potential hazard or unsafe practice which, if not avoided, could result in death or serious injury.

Caution

CAUTION

Caution indicates a potential hazard or unsafe practice which, if not avoided, could result in minor personal injury or product/property damage.

Note

NOTE

Notes provide application tips or other useful information to assure that you get the most from your equipment.

Service Information

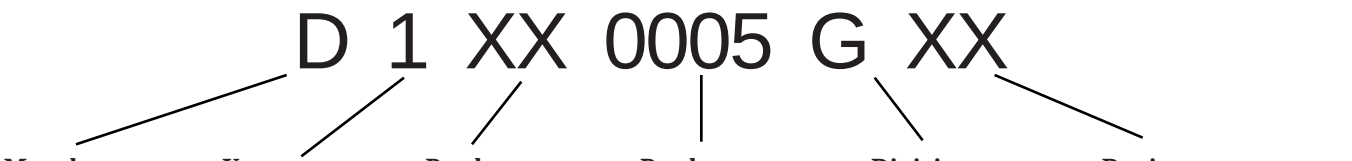
Service Requirements

Follow the service requirements listed below.

- Refer equipment servicing to Marquette Medical Systems' authorized service personnel only.
- Any unauthorized attempt to repair equipment under warranty voids that warranty.
- It is the user's responsibility to report the need for service to Marquette Medical Systems or to one of their authorized agents.
- Failure on the part of the responsible individual, hospital, or institution using this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.
- Regular maintenance, irrespective of usage, is essential to ensure that the equipment will always be functional when required.

Equipment Identification

Every Marquette Medical Systems device has a unique serial number for identification. The serial number appears on the back of the Tram Transport display. Refer to "Disassembly Procedure" in Chapter 2, "Troubleshooting," to disassemble the Tram Transport display from the Smart-pac battery backpack.



Month Manufactured
A = January
B = February
C = March
D = April
E = May
F = June
G = July
H = August
J = September
K = October
L = November
M = December

Year Manufactured
9 = 1989
0 = 1990
1 = 1991
2 = 1993
(and so on)

Product Code
Two-character product descriptor

Product Sequence Number
Manufacturing number (of total units manufactured.)

Division
F = Cardiology
G = Monitoring

Device Characteristics
One or two letters that further describe the unit.
For example:
P = Prototype - not conforming to marketing specification
R = Refurbished equipment
S = Special product documented under SPECIALS part numbers.

How to Reach Us

Customer Support and Equipment Repair Information

If you have questions about your monitoring equipment or if you need service for equipment repair call:

U.S.A. and Canada: **800-558-7044** (24-hour service)
Other countries: **561-575-5000** (During U.S. business hours only) or contact your local sales and service reprsntative

Local sales and service representative:_____
(Name and phone number)

Ordering Service Parts

Service parts are items that are not expended in the normal operation of the product. They are generally replacements for defective or malfunctioning items inside the product. Service parts include PCB assemblies, electronic components, internal cables and harnesses, software or firmware, and operator and service manuals.

A part number for the item to be replaced is necessary for ordering a service part. If the part number for the desired item is unobtainable, the following will be necessary to order the item:

- model and serial number of the equipment
- part number/name of the assembly where the item is used,
- item name, and where applicable, reference designation (e.g., R13, S12, U32).

Supplies Information

Supply items are generally those items used during normal operation of a product. Leadwires, electrodes, patient cables, printer paper, Aqua-Knot water traps, airway adapters, and calibration gases are examples of supply items.

Make telephone inquiries about supply items at:

U.S. only: 800-558-5102
Outside U.S.: 561-575-5070 (or contact your local sales and service representative)

Address orders or inquiries in the U. S. to:

Marquette Medical Systems Service and Supplies
Attention: Supplies Department
100 Marquette Drive
Jupiter, Florida 33468-9100

Fax: 561-575-5050

Abbreviations

	A
AAMI	Association for the Advancement of Medical Instrumentation
Ahr	ampere-hour
Al	aluminum
Ampl	amplifier
ANSI	American National Standards Institute, Inc
AWG	American Wire Gage
	B
BDGH	binding head
BP	blood pressure
BPM	beats per minute
	C
Cap	capacitor
Cer	ceramic
CMOS	complimentary metal-oxide semiconductor
Comp	composition
CSA	Canadian Standards Association
	D
dc	direct current
DDW	Direct Digital Writer
Dia	diameter
DIP	dual in-line package
	E
ECG	electrocardiogram, electrocardiograph
EPLD	electronically programmable logic device
ESD	electro static discharge
	F
FL	Florida
FLH	flat head
	I
IEC	International Electrotechnical Commission
in	inch
Inc	incorporated
	K
K	kilo, kilohm
kg	kilogram
	L
lb	pound
LCD	liquid crystal display
LED	light-emitting diode
	M
MEI	Marquette Electronics, Inc
MF	metal film
MHz	megahertz
mm	millimeter
mm	millimeter
mmHg	millimeter of mercury
MMS	Marquette Medical Systems
MPE	metallized polycarbonate epitaxial
mV	millivolt
mW	milliwatt
	N
No	number
Ntwk	network
	P
PAL	programmable array logic
PC	printed circuit, personal computer
pcb, PCB	printed circuit board
PLCC	plastic leaded chip carrier
pn, PN	part number
PNH	pan head
POS	positive
	R
RAM	random access memory
Res	resistor
Rgltr	regulator
	S
SD	schematic diagram
sec	second
SIP	single in-line package
SM	surface mount
SST	stainless steel
	T
Tant	tantalum
Tram, TRAM	Transport Remote Acquisition Monitor
TTL	transistor-transistor logic
	U
UL	Underwriters Laboratories, Inc
	V
V	volt, voltage
V	volt, voltage
Var	variable
	W
W	watt, West
w/	with
w/o	without
WI	Wisconsin
WW	wire wound
	Z
ZIF	zero insertion force
	Other
˚C	degrees Celsius
˚F	degrees Fahrenheit
µF	microfarad
Ω	ohm
%	percent

For your notes

1 General Information

WHAT IS IN THIS CHAPTER?

This chapter describes the equipment and lists the technical specifications.

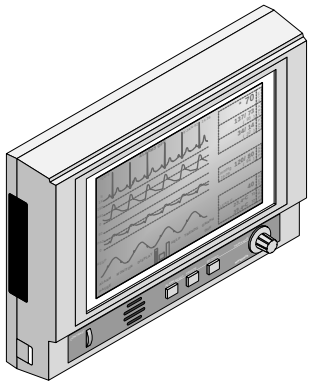
Contents

About the Smart-pac Transport Display 1-2
Caring for Your Smart-pac Battery Pack 1-5
Technical Specifications 1-7

About the Smart-pac Transport Display

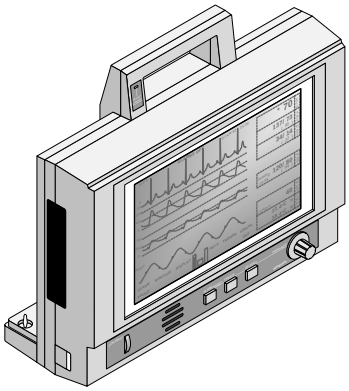
What is a Tram Transport Display?

In a Tram Critical Care Monitoring system, bedside and surgical monitors use Tram modules to collect patient data at the bedside area. The Tram Transport display presents the patient vital signs and waveforms collected by the Tram module on a backlit, supertwist LCD display. The name **Tram Transport Display** refers to the display only. For more details about the Tram Transport display, refer to chapter six in this manual.



What is a Smart-pac Transport Display?

When a Tram Transport display is connected to the Smart-pac battery backpack, the entire unit is referred to as a Smart-pac Transport display. The Tram module is then connected to the Smart-pac transport display when a patient is transported from one hospital area to another. For more details about the Smart-pac Transport display, refer to Chapter Five, “Smart-pac Transport Display,” in this manual.



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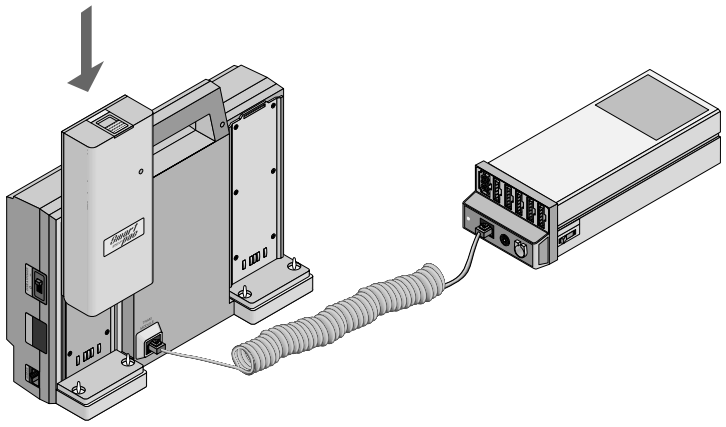
→ About the Smart-pac Transport Display

What is a Smart-pac Battery Backpack?

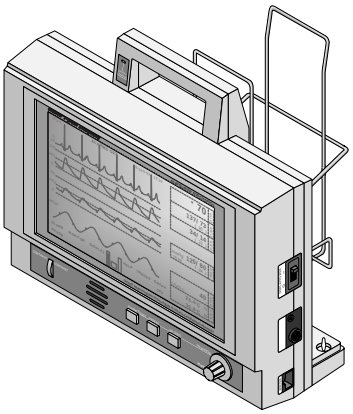
By sliding a Smart-pac battery pack or power supply into either slot at the back of the Smart-pac Transport display, both the Tram module and display receive power. Pictured below is a Smart-pac Transport Display with the battery backpack connected to a Tram module. For more details about the Smart-pac Battery backpack, refer to "Caring for Your Smart-pac Battery Pack" on the following pages and in Chapter 10 in this manual.



For more details about the Smart-pac charger and power supply, refer to the *Smart-pac Charger Service Manual,* (pn 403596-030) or *Smart-pac Power Supply Service Manual,* (pn 403596-033).

What is a module holder?

Pictured below is the Smart-pac Transport display with battery pack and module holder assembly. For more details about the module holder assembly, refer to Chapter 10 in this manual.



How do I graph the waveforms?

The Smart-pac Transport display may also connect to a Direct Digital Writer (DDW) for graphing patient data. The following pages describe the DDW connector. To use the Smart-pac with a DDW, refer to the appropriate Smart-pac transport display operator's manual.

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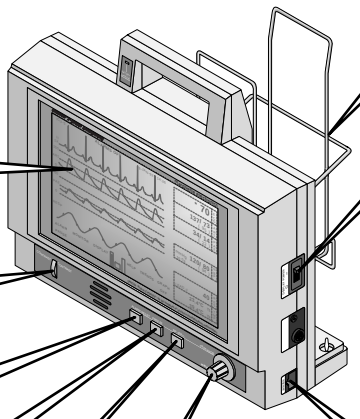
→ About the Smart-pac Transport Display

Parts of the Smart-pac Transport Display



Module Holder. The Tram module is usually stored in here during transport.

Display. A fluorescent-backlit, double super-twisted LCD display for showing patient data.

POWER Switch. Turns the transport display on and off.

CONTRAST Control. Adjust this control to get the best image for your viewing angle.

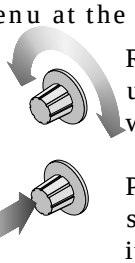
ALARM RESET Key. Press this key to clear alarms.

FREEZE Key. Press this key to stop the waveforms on the display.

DDW Connector. Plug a DDW (Direct Digital Writer) in here to graph the patient's vital signs and waveforms.

BP ZERO Key. Press this key to set the zero reference point of all pressure inputs for the Tram module.

TRIM KNOB Control. Use this control to choose items from the menu at the bottom of the display.

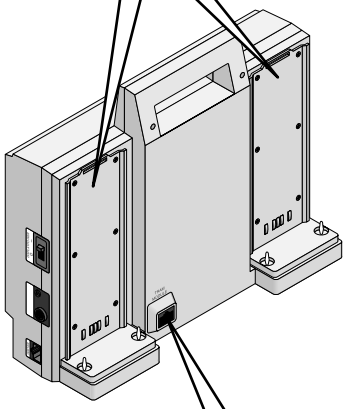


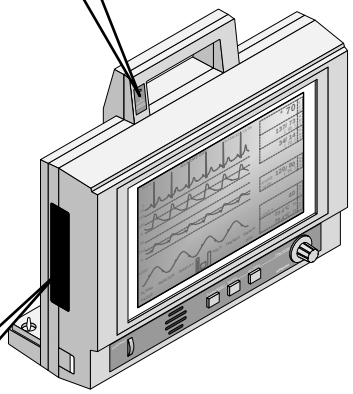
Rotate the control until the item that you want is highlighted.

Press the control to select the highlighted item.

Smart-pac Rails. Slide a Smart-pac battery pack or power supply onto one or both of these to supply the transport display and Tram module with power.

CHARGING Indicator. If you install a Smart-pac battery pack on one rail, and a Smart-pac power supply on the other rail, this indicator lights to show when the battery is charging.





TRAM MODULE Connector. Make sure you plug the Tram module into this connector. If you plug it into one of the other connectors, you'll see a big **COMMUNICATION FAILURE** message on the display.

SOFTWARE CARTRIDGE Cover. The software cartridge lives under this cover. You might replace it if you do your own software updates. If you do, make sure you read the *Update Instructions* that come with the new software cartridge before you replace it.

→

Caring for Your Smart-pac Battery Pack

The Smart-pac battery pack is shipped fully charged. To ensure optimum performance, *please recharge* in a Smart-pac Charger before the battery is put into service.

NOTE

Always make sure you fully charge this battery pack before you use it with a patient.

The following tips should help you get the longest life and best performance from your Smart-pac battery pack.

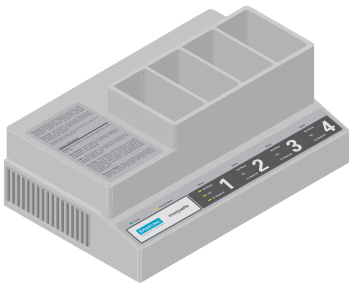
Storing the Battery Pack

We recommend that you store the battery pack in a Smart-pac battery charger when you are not using it. The shelf life of the battery is four weeks, and it is *very important* that you fully charge it in a Smart-pac battery charger at *least once* every four weeks.

Smart-pac 2 batteries require the following Smart-pac Backpack and Smart-pac Charger software:

- Smart-pac Backpack Version 2A or later.
- Smart -pac Charger Version 2A or later.
- Series 7240 Charger Version 2A or later.
- Series 7250 Charger Version 1A or later.

Using the Smart-pac Charger



If you place your battery pack in a Smart-pac charger, and its voltage is below 10 volts, the charger NOT READY indicator should light for about 10 minutes while it trickle-charges the battery.

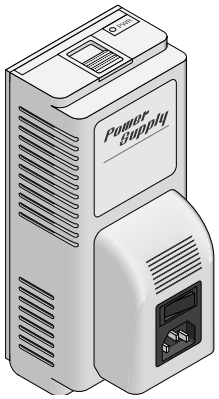
It takes about 75 minutes to charge a fully discharged Smart-pac battery pack with a Smart-pac charger.

When you place your battery pack into a Smart-pac charger, and you have not exercised the battery pack for 50 days or 100 charge cycles, the charger EXERCISE indicator lights. exercising the battery pack prolongs its life by first charging the battery, fully discharging it,and then fully charging it again.

Press the EXERCISE key on the charger rear panel to start the exercise cycle. An exercise cycle may take up to three hours, depending on the battery pack's capacity. The charger always fully charges all batteries before it begins any exercise cycles.

→ Caring for Your Smart-pac Battery Pack

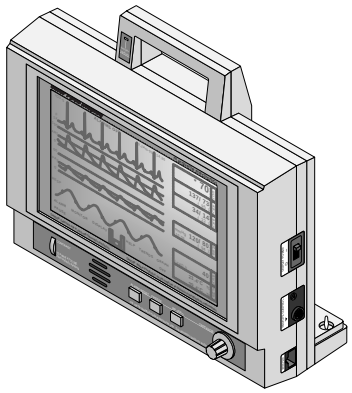
Using a Smart-pac Power Supply



If you use a Smart-pac power supply with your Smart-pac transport display, the power supply can charge a Smart-pac battery pack while it runs the transport display. However, it can take up to 16 hours to fully charge the battery.

Even if you use a power supply with your battery pack and transport display, you still need to place your battery pack in a Smart-pac battery charger at *least once* every four weeks, so the battery charger can exercise your battery pack.

Using a Smart-pac Transport Display



If the battery pack does not work with your Smart-pac display, make sure the battery backpack on your transport display has the latest version of software. Call your sales representative for software updates.

NOTE

It is *very important* to make sure you fully charge this battery pack before you use it on a patient.

For technical advice concerning your monitoring system, contact Tech Support—Monitoring Hardware.

→

Technical Specifications

Performance Specifications

Size:	9-inch diagonal
Type:	Fluorescent backlit passive monochrome LCD
Resolution:	640 x 400 pixels
Number of traces:	4
Number of seconds/trace:	5
Sweep speed:	24.8 mm/sec, crystal controlled ±0.1%
Operating time:	Using one Smart-pac 2.4-Ahr battery pack
Typical:	75 to 105 minutes with battery charged to 100% of rated capacity
Nominal:	60 to 75 minutes with battery charged to 80% of rated capacity

Environmental Specifications

Operating Conditions

Ambiant temperature:	10˚C to 35˚C (50˚F to 95˚F)
Relative humidity:	40% to 95% (noncondensing)

Storage Conditions

Ambiant temperature:	–10˚C to 50˚C (15˚F to 122˚F)
Relative humidity:	0% to 95% (noncondensing)

Power Requirements

Voltage:	12V DC
Power:	6 watts

Physical Specifications

Height:	25.4 cm (10 in)
Width:	31.8 cm (12.5 in)
Depth:	9.5 cm (3.3 in)
Approx. weight:	5.7 kg (12.5 lb) (with two batteries)

Certification

UL:	UL544 Listed
CSA:	CSA No 125 Certified
IEC:	IEC 601-1 Certified

→

→ Technical Specifications

Classification

	The Smart-pac Power Supply is classified, according to IEC 601-1, as:
Type of protection against electrical shock:	Class I Equipment or Internally Powered Equipment
Degree of protection against electrical shock:	Not Marked
Degree of protection against harmful ingress of water:	Ordinary Equipment (enclosed equipment without protection against ingress of water)
Degree of safety of application in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide:	Equipment not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.
Method(s) of sterilization or disinfection recommended by the manufacturer:	Not Applicable
Mode of operation	Continuous operation

2 Troubleshooting

WHAT IS IN THIS CHAPTER?

This chapter contains information that can help you repair the Smart-pac transport display more effectively. It includes information about some types of components that are used in Smart-pac transport display, but not yet widely used in the field, and some troubleshooting tips for communication problems.

Contents

Considerations for Special Components 2-2
Replacing the LCD Display 2-4
Disassembly Procedure 2-5
Problems and Solutions 2-11

Considerations for Special Components

CMOS Components

The Smart-pac transport display makes extensive use of CMOS components. CMOS components are more immune to noise and consume less power than standard TTL or NMOS components. However, CMOS components are inherently more susceptible to electrostatic discharge (ESD) damage than other semiconductors. ESD damage, usually a subtle weakening of semiconductor junctions, can range from corruption of digital memory to catastrophic failure and can render one (or more) components permanently unusable. Although it is more common for CMOS components to fail from ESD damage, *no semiconductor device is completely immune to ESD damage.*

The inputs and outputs of the Smart-pac transport display are protected from ESD damage; they are no more susceptible to ESD damage during normal operation than other devices. However, when you service the equipment, the components within are exposed to several sources of static electricity, ranging from human hands to improperly grounded test equipment. For this reason, it is suggested that all service workstations be as static-free as possible.

The following guidelines can help make your workstation more resistant to the damage that can be caused by static electricity.

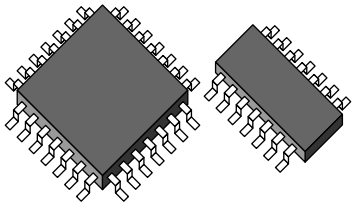
- A grounded, antistatic wristband (3M part number 2046 or equivalent) or heelstrap should be worn at all times when repairing assemblies containing semiconductors.
- Discharge any built up static charge before handling semiconductors or assemblies containing semiconductors.
- Use only properly grounded soldering and test equipment.
- Use a static-free surface (3M part number 8210 or equivalent) when working on assemblies containing semiconductors.
- **Do not** remove semiconductors or assemblies containing semiconductors from antistatic containers (bags) until needed.
- Make sure power to an assembly is turned off before removing or inserting a semiconductor.
- **Do not** slide semiconductors or assemblies containing semiconductors across any surface.
- **Do not** touch semiconductor leads unless absolutely necessary.
- Semiconductors and assemblies containing semiconductors should be stored only in antistatic bags or boxes.

Although these items cannot ensure a 100% ESD-free workstation, they can greatly reduce the failure rate of any semiconductors that are serviced.

→

➔ Considerations for Special Components

Surface Mounted Components



Surface mounted components aid in miniaturizing the Smart-pac transport display.

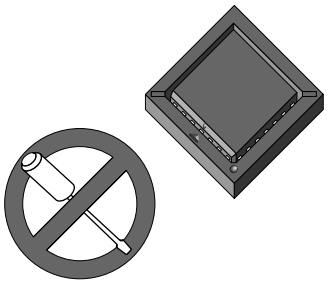
Surface mounted integrated circuits have legs soldered to rectangular pads on the surface of the circuit board, rather than legs that are inserted into holes that go through the circuit board. Surface mounted integrated circuits can have legs on either two or four sides of the chip.

Surface mounted resistors, capacitors, and diodes usually have no legs at all – conductive parts of their bodies are soldered directly to the circuit board.

CAUTION

Surface mounted components were not designed to be removed and replaced with standard soldering equipment. Removing a surface mounted component with a conventional soldering iron could destroy the circuit board. Special equipment is required to remove and replace these items.

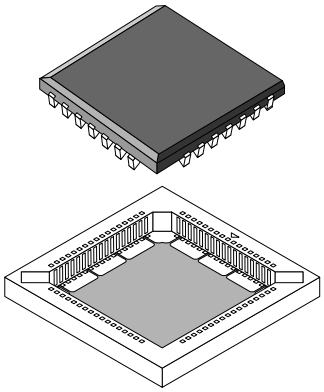
Plastic Leaded Chip Carriers



Plastic leaded chip carriers (PLCCs) also save space. PLCCs have conductors on all four sides and are usually used with special sockets. They do not have legs like a conventional integrated circuit, but rather “loops” that make contact with the socket or circuit board when they are inserted.

CAUTION

Removing and inserting PLCCs requires a special tool (Burndy QILEXT-1 or equivalent). If you use a screwdriver to remove or replace a PLCC, you may damage the PLCC or the socket.



If you must troubleshoot the circuitry under the PLCC socket, carefully remove the PLCC. Next, *carefully* break out the square socket bottom with a knife so you can probe the circuit board below.

When you finish troubleshooting, make sure to replace the square bottom socket before you insert the PLCC again or replace the whole socket with the correct socket replacement part. Refer to the appropriate parts list in this manual. The socket provides necessary spacing between the bottom of the PLCC and the circuit board.

Replacing the LCD Display

If your LCD display is damaged, you need to order one of three Smart-pac Display Retrofit kits available to replace it. The serial number located on the back of the Tram Transport display determines which of the three replacement kits you need.

To view the serial number, use the disassembly procedure provided later in this chapter to separate the Smart-pac battery backpack from the Tram Transport display. For an explanation on how to read the serial number digits, refer to “Equipment Identification” in the *Introduction* of this manual.

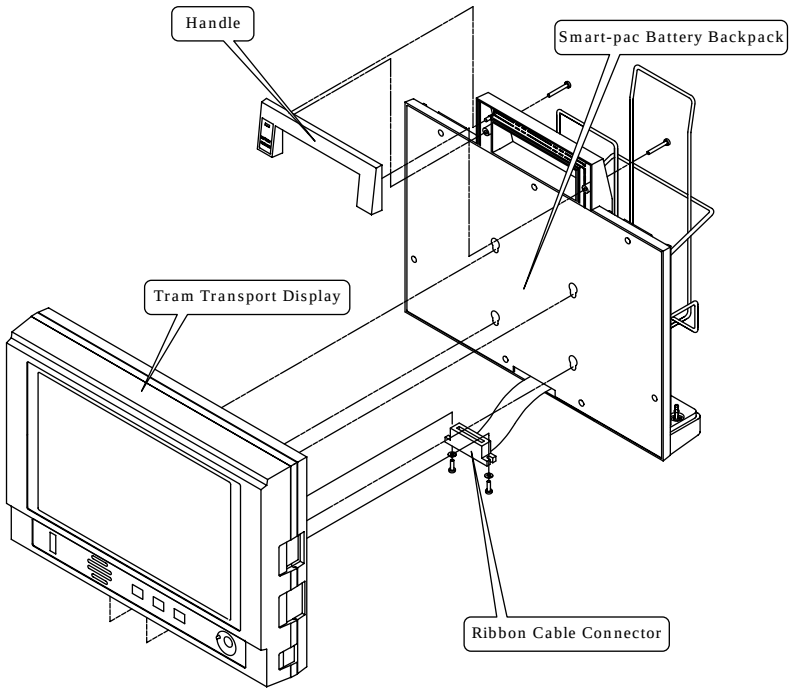
- If the product code of the serial number is “JW,” order retrofit kit, pn 414091-001. This kit includes detailed instructions about how to rework the display processor PCB, pn 85638-002 revision M or later. If your display processor PCB is an earlier version, the PCB cannot be reworked and must be replaced. Call Tech Support at 1-800-558-7822 for details.
- If the product code of the serial number is “LG” and product sequence number is from 001 to 190 (except 186), order retrofit kit, pn 414091-002. This kit includes a new flex circuit and LCD display. The new flex circuit is required because the older flex circuit was soldered directly to the LCD display and will be discarded with it. You may use the disassembly procedure included in this chapter to replace your LCD display.
- If the product code of the serial number is “LG” and the product sequence number is 186, 191 or later, order retrofit kit, pn 414091-003. This kit includes only the LCD and you may use the disassembly procedure included in this chapter to replace your LCD display.

Disassembly Procedure

Remove Optional Smart-pac Battery Backpack

These are the recommended steps to disassemble the major components of the Smart-pac Transport display. Keep all hardware for re-assembly.

1. Remove the two screws from the rear of the handle and remove the front of the handle from the Smart-pac battery backpack.
2. Remove the two screws and washers recessed in the bottom of the Tram Transport display that secure the ribbon cable connector from the Smart-pac battery backpack to the Tram Transport display.
3. Disconnect the ribbon cable connector from the Tram Transport display board-edge connector.
4. Slide the Smart-pac battery backpack downward to disengage the mounting buttons from the keyhole-shaped mounting slots located on the Smart-pac battery backpack front cover.
5. *Carefully* separate the Tram Transport display from the Smart-pac battery backpack.



→ Disassembly Procedure

Disassemble the Tram Transport Display

1. Remove the six screws from around the rear perimeter of the Tram Transport display that secures the front and back display case. Refer to the figure on the next page.

CAUTION

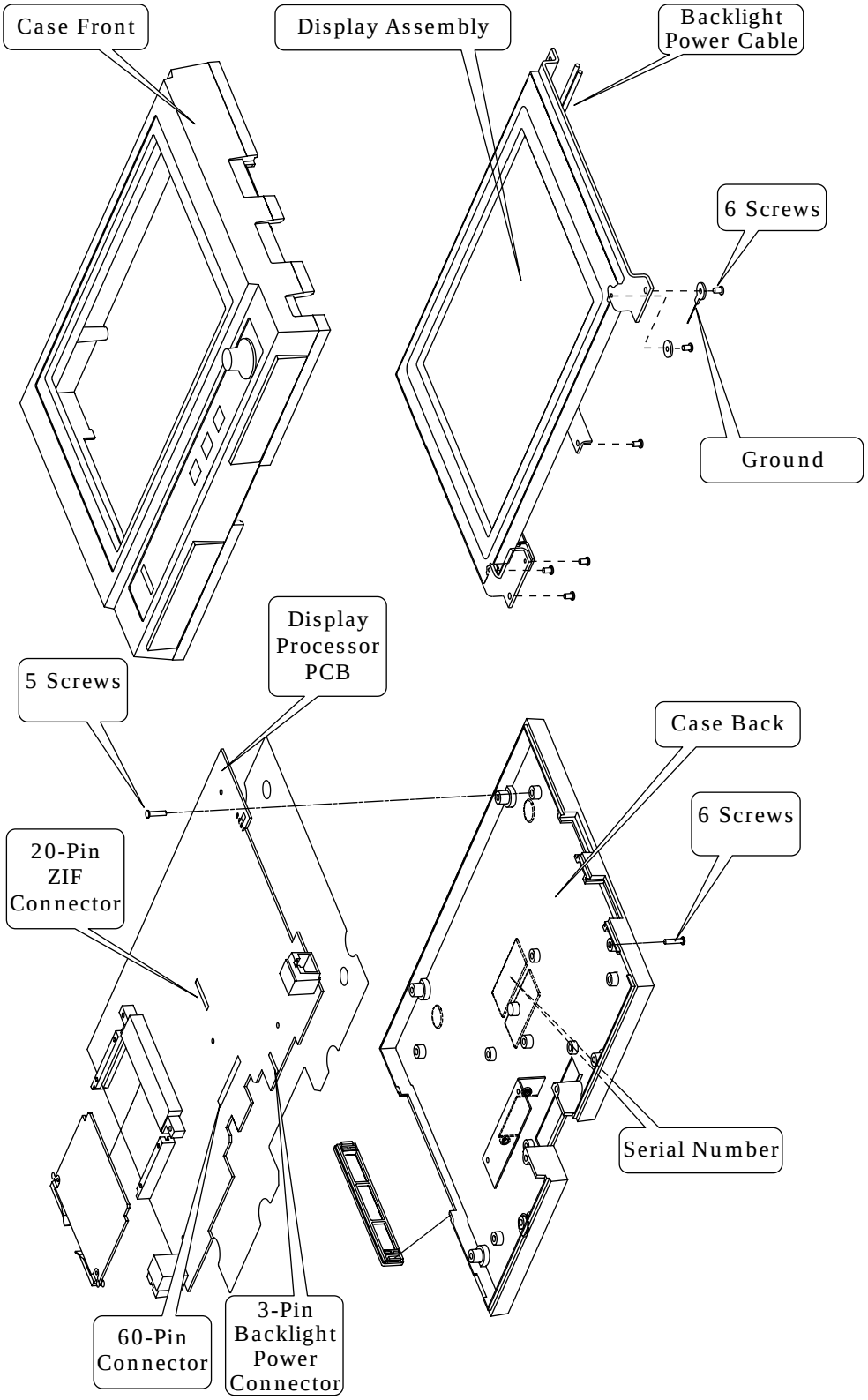
For the next step, there are cables and connectors inside the Tram Transport display that could possibly be stressed when the front and back display cases are separated. As you look at the unit, open it slightly on the *right first* instead of opening it along the top edge to avoid ripping the flex circuit.

2. *Carefully separate* the case front and back display cases so you do not damage the cables or connectors.
3. Disconnect the cables/harnesses listed below that provide interconnection for the display processor PCB and front panel switches to the display assembly. Refer to the figure on the next page.
   - Disconnect the horizontal 60-pin connector and ribbon cable from the front display case.
   - At the display processor PCB, slide the slip-ring lock mechanism of the horizontal 20-pin zero insertion force (ZIF) connector. *Gently* pull the flex circuit from the ZIF connector,
   - Disconnect the 3-pin display power cable from the connector on the display processor PCB (disengage the interlock to release the cable harness).

→

→ Disassembly Procedure

Use the figure below to assist with the disassembly procedure.

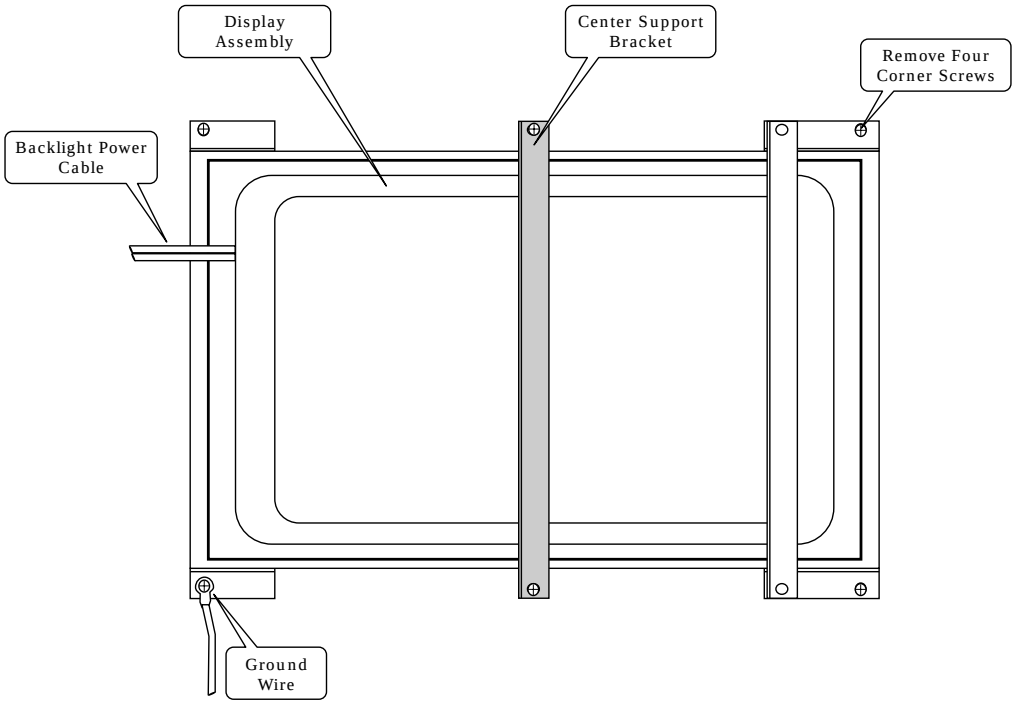


→

→ Disassembly Procedure

4. Remove the two screws and washers that secure the center support bracket to the display front case.
5. Remove the screw which secures a ground cable ring connector to the display mounting bracket.
6. Remove the three outside screws to replace the display assembly.
7. To replace the display processor PCB, remove the five screws securing the display processor PCB to the back display case.
8. While using electrostatic discharge (ESD) protection, remove the display processor PCB.

Perform any necessary service at this time.



→

→ Disassembly Procedure

Re-assemble the Tram Transport Display

1. Use a lint-free cloth to clean the inside of the protective filter lens affixed to the front display case. Remove fingerprints, dust, or smudges from the protective filter lens. *Carefully* wipe the outer lens of the retrofit display assembly to remove fingerprints, dust, or smudges as well.

   CAUTION

   Apply very light pressure with a continuous motion over the new display outer lens to remove any fingerprints, dust or smudges. **Do not** use excessive pressure when wiping it down because it may damage the display.

   NOTE

   Protect the clean surfaces. Fingerprints, dust, or smudges left on the surfaces mentioned above are annoyingly visible when the Tram Transport Display is turned *ON* when you re-assemble to unit.

2. Install the new display assembly provided in the kit into the front display case.

   NOTE

   Orient the new display assembly with the backlight power cable to the *left* and the flex circuit to the *right* of the display assembly when viewed from the inside of the front display case.

3. Fasten the four screws to the corners of the new display assembly with the ground cable in the lower left corner when viewed from the inside of the front display case. Center the new display assembly with respect to the rectangular opening in the front display case.
4. Remount the center support bracket with the two screws in the mounting holes in the front display case.
5. Install the display processor PCB into the back display case and secure with the hardware you removed earlier. Attach the other end of the ground cable-ring connector to the mounting hole of the display processor PCB lower-right corner last. Orient the ground cable so that it does not interfere with the front and back display case when assembled together.
6. Connect the cables and harnesses listed below that provide interconnection between the display processor PCB, front panel switches, and display assembly.
   - Observing correct orientation, connect the two-wire backlight power cable to the connector on the display processor PCB.

→

→ Disassembly Procedure

→ Re-assemble the Tram Transport Display

- Attach the 60-pin flex circuit connector from the control panel assembly to connector on the display processor PCB.
- *Carefully* insert the 20-pin flex circuit from the display assembly into ZIF connector on the display processor PCB with the contact points *facing you* (away from the PCB). Ensure the flex circuit aligns properly in the connector. Orient the flex circuit so that there are no twists and make sure that it is centered and straight with respect to the ZIF connector. Secure the flex circuit into the connector by sliding the slip-ring mechanism toward the base of ZIF connector locking the flex circuit into place.

8. With the back case on the bottom, carefully fold all flex circuits, ribbon cables, and cable harnesses into a position where they cannot get kinked, nicked or compressed.

CAUTION

Do not pinch any internal flex circuits, ribbon cables, or cable harnesses. Make sure that all internal cables **do not** obstruct any of the screws used to secure the front and back display cases.

9. Seat the power switch and external connector mounting plates into the respective openings provided in the front and back display cases.Secure the front and back display cases with the hardware you removed earlier.

Connect Optional Smart-pac Battery Backpack

1. For the optional Smart-pac Battery Backpack, connect the ribbon cable connector from the Smart-pac Battery Backpack to the Tram Transport display with the two screws and lock washers.
2. Align and insert the mounting buttons located on the display case back into the keyhole-shaped mounting slots on the Smart-pac Battery Backpack front cover. Slide the Tram Transport Display down as far as it can go. The tops and bottoms of the Tram Transport Display and Smart-pac Battery Backpack should be flush with respect to each other.
3. Install the BATTERY CHARGING indicator LED into the mounting hole on the Smart-pac Battery Backpack front handle piece and align the LED cable harness so it cannot interfere with installation of the handle.
4. Align the front handle piece with the Smart-pac Battery Backpack housing and secure the front handle piece with hardware previously removed. Once the front handle piece is installed, the Tram Transport Display is locked in place to the Smart-pac Battery Backpack.

Completion

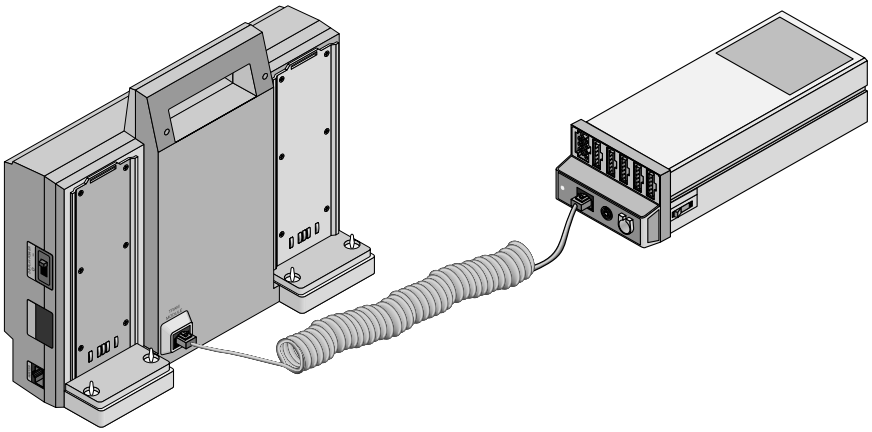
Perform the Check Procedure found in Chapter 4, “Preventive Maintenance,” in this manual before returning to service.

Problems and Solutions

Here are a couple of problems that Marquette service personnel have encountered with Smart-pac transport displays, and descriptions of how they solved them.

Problem: The transport display shows a big COMMUNICATION FAILURE message and won't display any waveforms.

Solution: Using the wrong connector on the transport display usually causes this problem. Make sure that you're plugging the Tram module into the connector on the *back* of the transport display. The two connectors on the sides do not work for the Tram module.



If you use the correct connector but you still see the COMMUNICATION FAILURE message, try the following steps.

- Unplug the cable between the Tram module and the transport display and plug it back in.
- Replace the cable between the Tram module and the transport display with a known good one.
- Reseat the connector on the bottom of the transport display. It connects the transport display assembly to the battery backpack assembly, and all communication signals between the Tram module and transport display go through it.
- The transport display is designed to withstand the rigors of transporting patients, but sometimes connectors disconnect and integrated circuits unseat. Disassemble the battery backpack assembly. When you're inside it, disconnect and reseat all of the connectors. If you have a PLCC extractor, you can also carefully remove and reseat microcontroller U3 on the battery interface PCB. If this step works, make sure that you do the Checkout Procedures listed in Chapter 4, "Preventive Maintenance."

→

→ Problems and Solutions

→ Solution:

- Take the battery backpack assembly off of the transport display assembly, and try it on a different transport display. Likewise, you can try a different battery backpack assembly on the transport display assembly.
  - ∞ If the problem is with the battery backpack assembly, replace the battery interface PCB with a known good one.
  - ∞ If the problem is with the transport display assembly, replace the display processor PCB with a known good one.

Problem: The transport display won't turn *ON*.

Solution:

- Adjust the CONTRAST control on the front panel. If this control is turned all the way down, the transport display looks like it's been turned *OFF*.
- If you're using Smart-pac battery packs to power the transport display, make sure they are fully charged. Make sure the READY light lights on the Smart-pac charger before you use the battery pack with a transport display. If the EXERCISE light is *ON* for the battery, make sure that you exercise the battery pack before you use it again (press the EXERCISE switch by the power cord connector on the Smart-pac charger).
- If you just bought new battery packs, they were probably Smart-pac II battery packs. If you want to use the new battery packs, you might have to update the software in the battery backpack assembly to version 2A or later. The *Smart-pac Battery Backpack Version 002 Update Instructions* (pn 403596-034) shows you how to do this.
- Remove the battery backpack assembly from the transport display assembly and swap these items with ones from a working transport display.
  - ∞ If the problem is with the battery backpack assembly, disassemble the battery backpack assembly. Once inside it, disconnect and reseat all of the connectors. If you have a PLCC extractor, you can also carefully remove and reseat microcontroller U3 on the battery interface PCB. If this step works, make sure that you do the Checkout Procedures listed in Chapter 4, "Preventive Maintenance." If it doesn't, swap the battery interface PCB with a known good one.
  - ∞ If the problem is with the transport display assembly, replace the display processor PCB with a known good one. If that doesn't fix it, the problem is probably in the LCD display itself.

3 Calibration

WHAT IS IN THIS CHAPTER?

This chapter describes how and when to adjust the equipment. It also describes the Smart-pac transport display's internal switches and jumpers.

There are only two circuit boards in the Smart-pac transport display that have adjustments, switches, and jumpers: the display processor PCB (pn 800814 *or* pn 85638) and the battery interface PCB (pn 403861).

Contents

Display Processor PCB PN 800814 3-2
Display Processor PCB PN 85638 3-4
Battery Interface PCB PN 403861 3-9

Display Processor PCB PN 800814

Audio Volume Adjustment

Variable resistor **R32** sets the Smart-pac transport to display a consistent volume level. The speaker volume is adjusted in the factory to a particular amplitude.

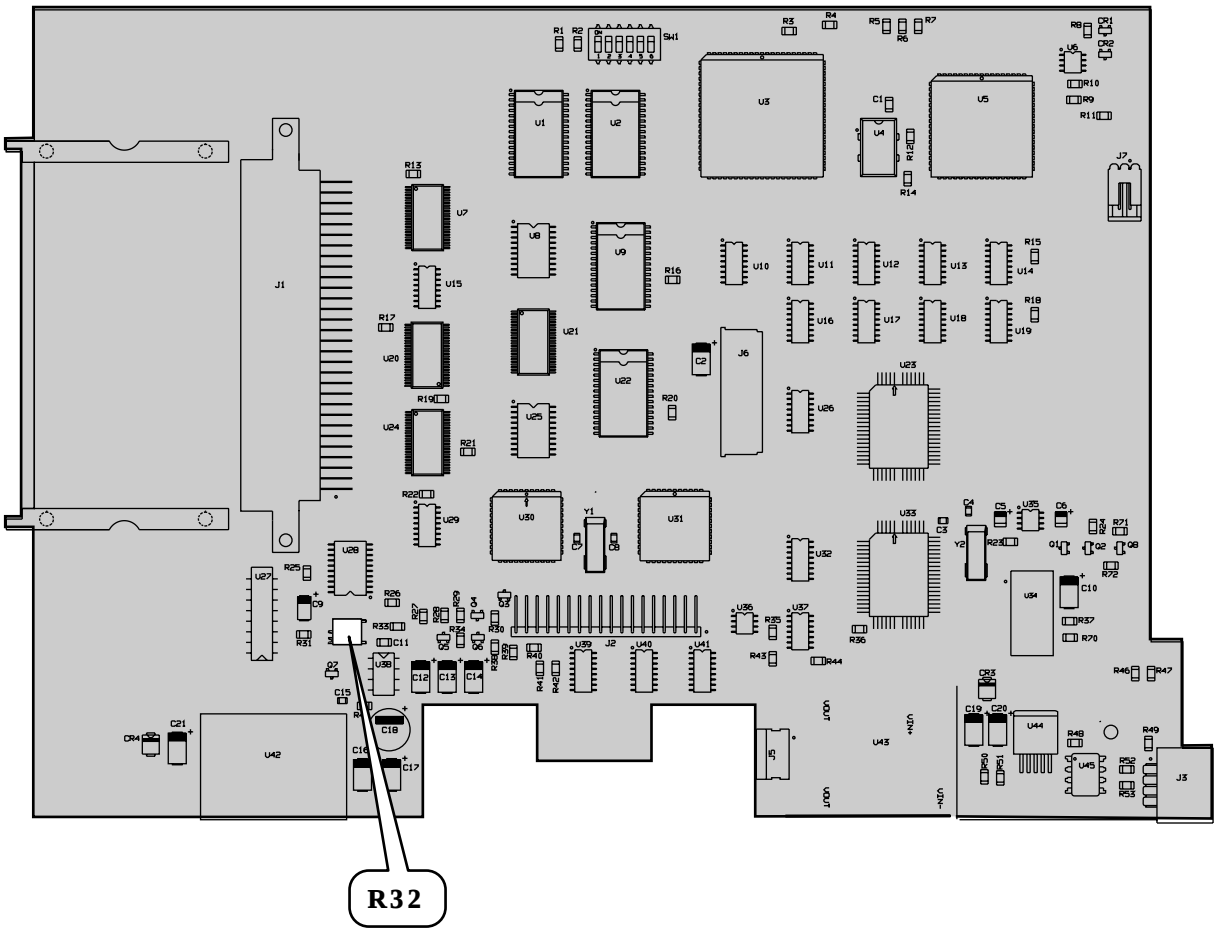
NOTE

This is not a recommended field adjustment, but be aware that changing the speaker assembly changes the speaker volume.

If you perform checkout procedures on a transport display after a repair and you notice that the alarm volume is much louder or quieter than other transport displays in your hospital, adjust variable resistor **R32** to fix this problem.

CAUTION

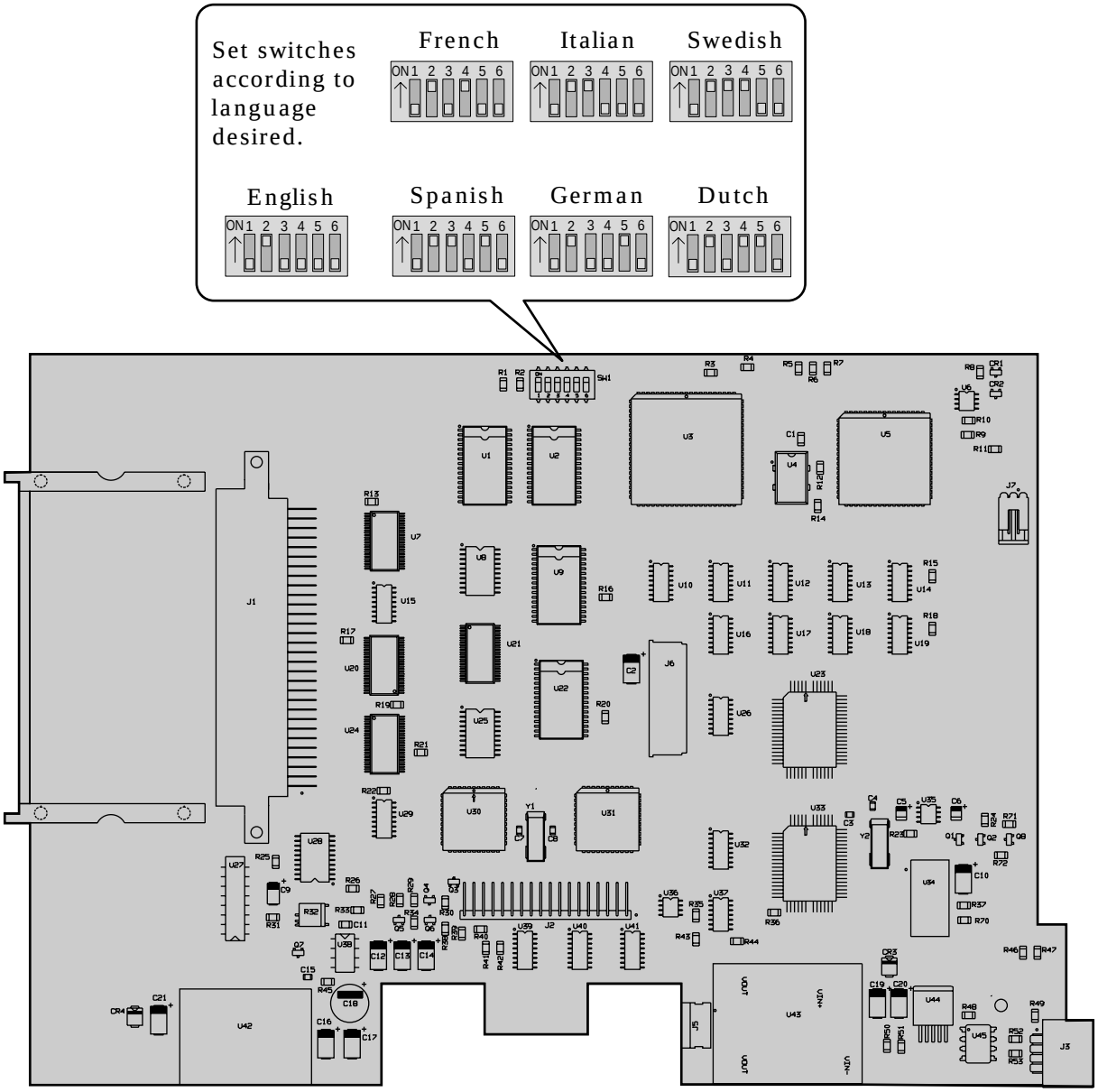
Check the alarms after you adjust the speaker voltage. If the adjustment is too high, it can overdrive the speaker; if it is low, it can shut off the alarms.



➔ Display Processor PCB PN 800814

Switch Settings

There is one DIP switch on the display processor PCB. When you replace a display processor PCB, make sure that the switches on the new circuit board are correct. The figure below shows how to set the switches on the new circuit board.



Display Processor PCB PN 85638

Earlier versions of the Tram Transport Display used the pn 85638-00x display processor PCB. Variable resistor **R84** is used to set the intensity of the fluorescent backlight to a consistent level in the factory.

If you replace the LCD display assembly or any of the following components on the display processor PCB, you should calibrate the backlight level:

Q3	**R84**	**R87**
R100	**T1**	**U69**

Display Backlight Intensity Adjustment

Do the following to calibrate the display backlight intensity:

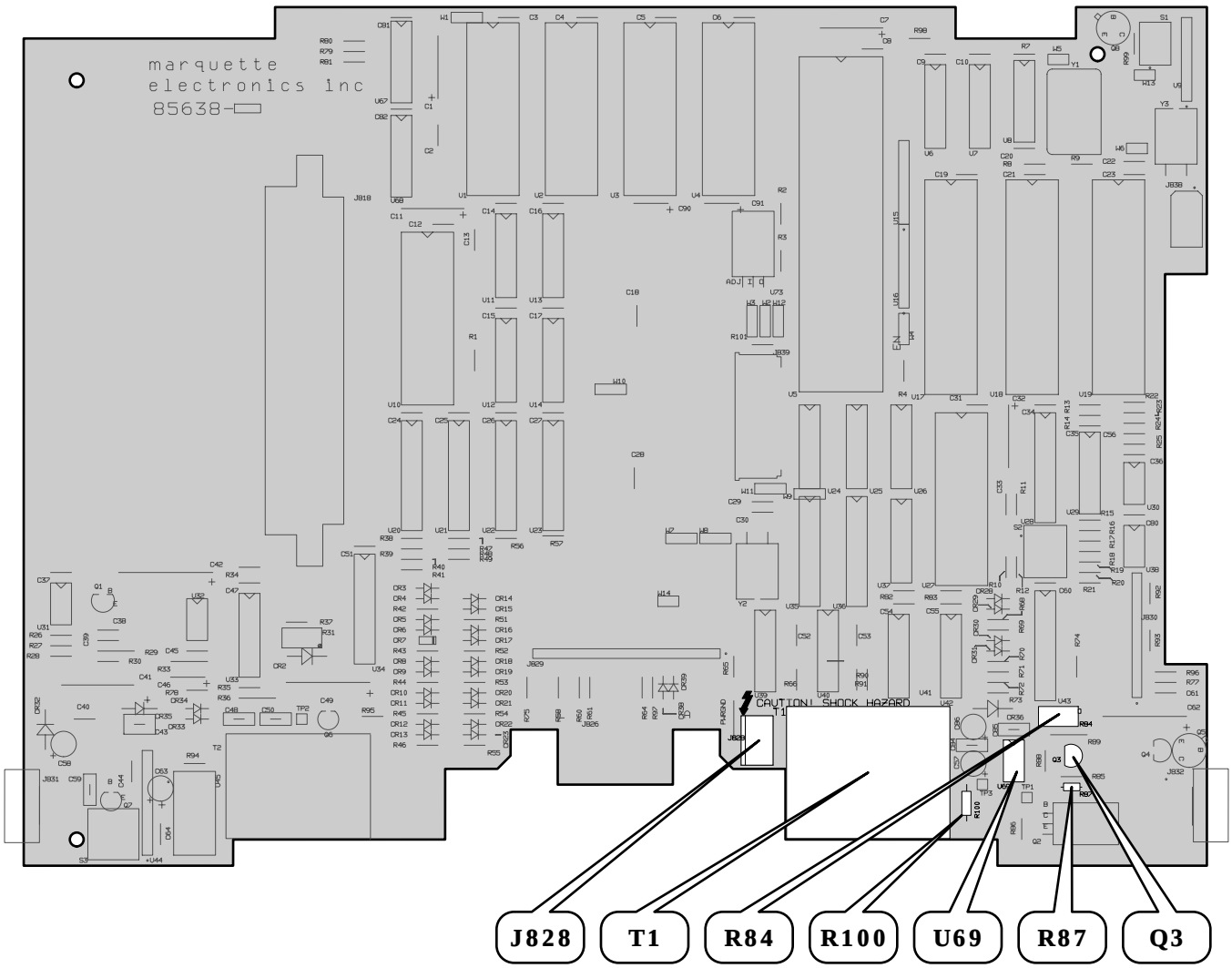
1. Turn the transport display *OFF*.
2. Attach all cables to the display processor PCB. This includes the cable to the backlight of the LCD display assembly, and the cable to the battery backpack assembly.
3. Attach a digital voltmeter across resistor **R100** on the display processor PCB.

> **WARNING**
>
> In the following step, apply power to the transport display. When you apply power, the output side of inverter T1 develops over 700 volts to dive the fluorescent backlight tubes in the LCD display assembly. Make sure you ***do not*** *touch* inverter T1, connector J828, or the bottom side of the circuit board while power is applied.

4. Turn the transport display *ON*.
5. Adjust variable resistor **R84** until the digital voltmeter reads 140 millivolts.

➔ Display Processor PCB PN 85638

➔ Display Backlight Intensity Adjustment



➔ Display Processor PCB PN 85638

Audio Volume Adjustment

Variable resistor **R31** is used to set the Smart-pac transport displays to a consistent volume level. The speaker volume is adjusted in the factory to a particular amplitude.

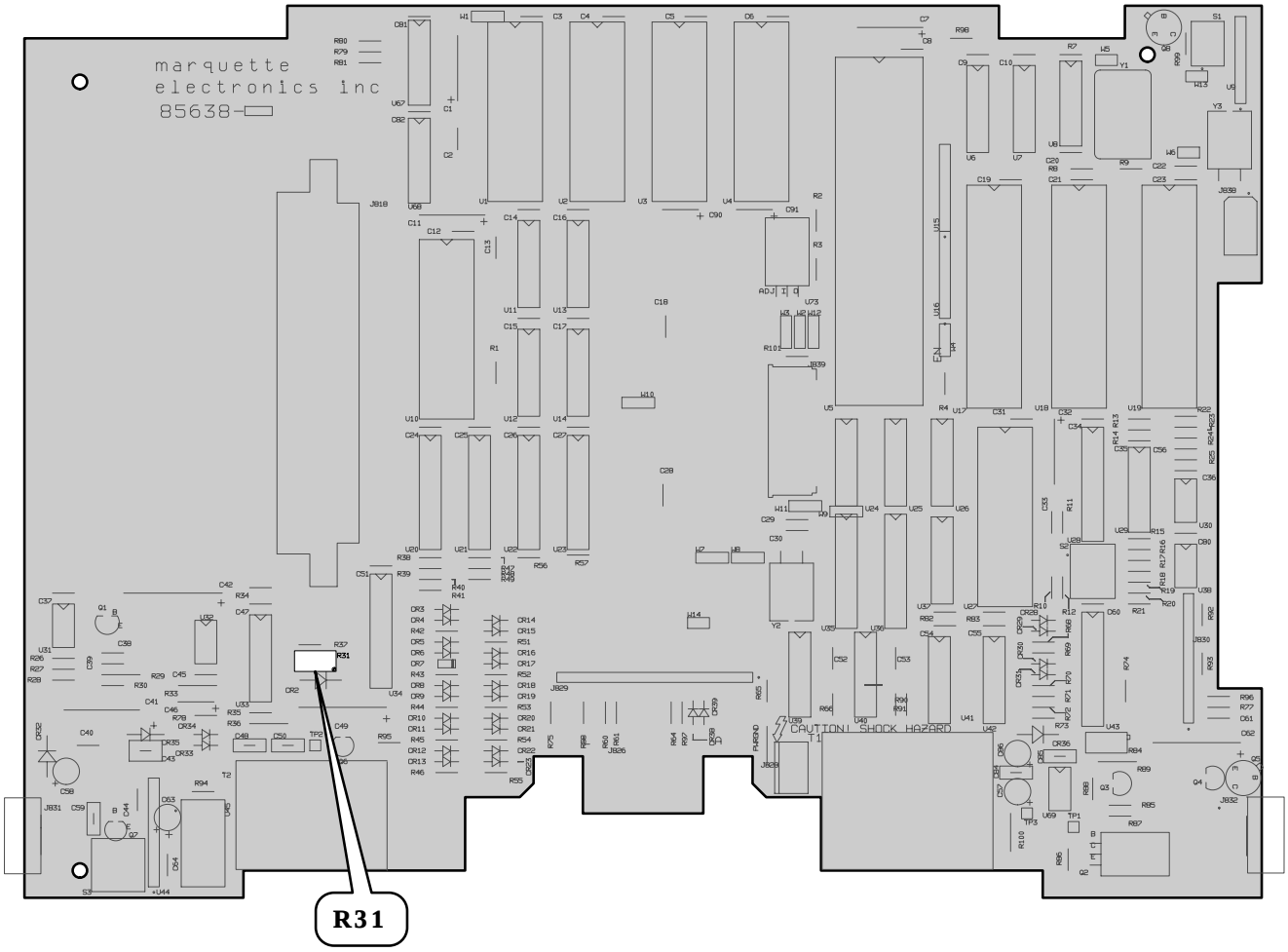
NOTE

This is not a recommended field adjustment, but be aware that changing the speaker assembly changes the speaker volume.

If you perform a checkout procedure on a transport display after a repair and you notice that the alarm volume is much louder or quieter than other transport displays in your hospital, you may adjust variable resistor **R31** to fix this problem.

WARNING

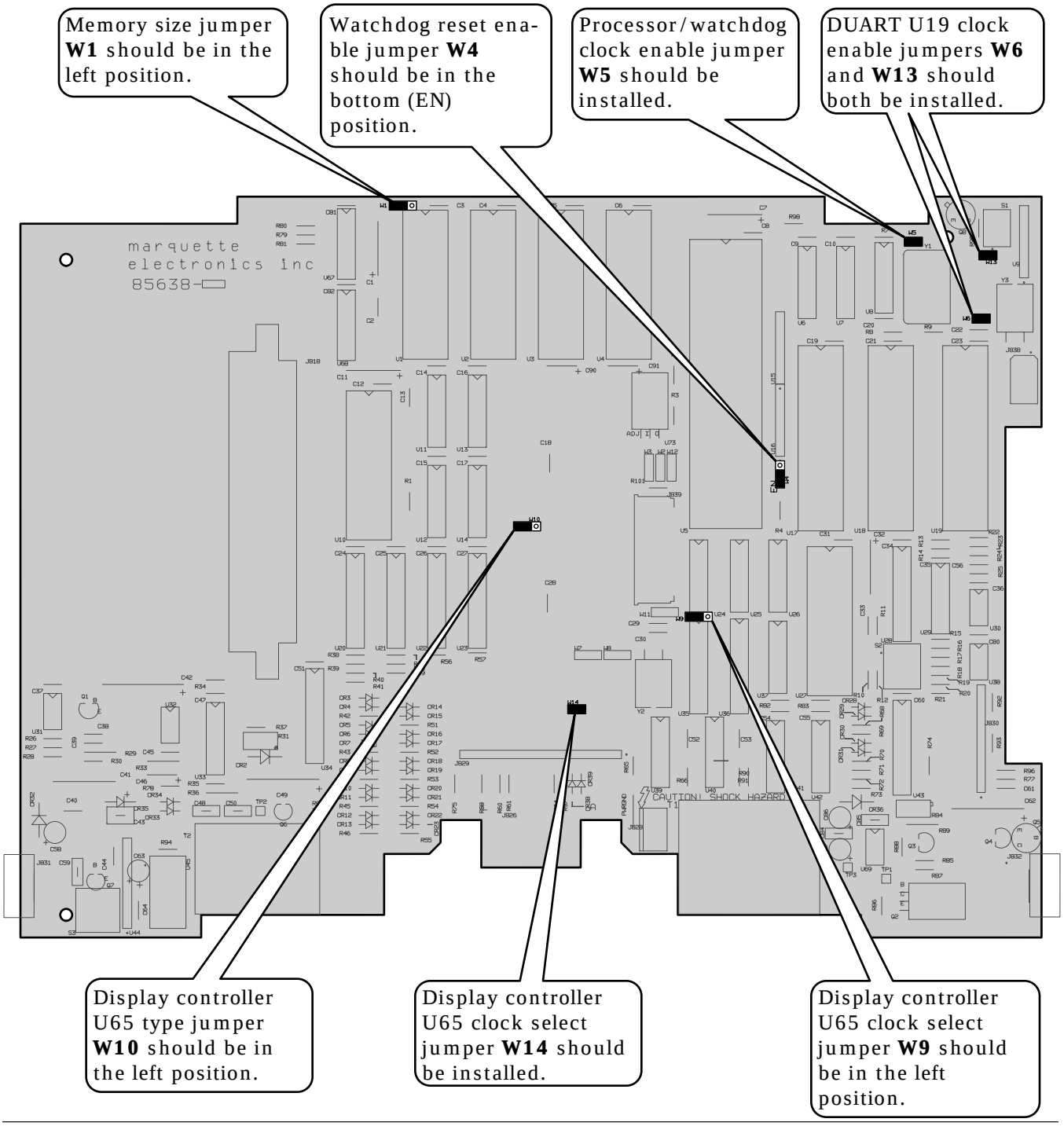
Recheck the alarms after adjusting the speaker voltage. Too high an adjustment will overdrive the speaker and too low will shut off the alarms.



➔ Display Processor PCB PN 85638

Jumper Settings

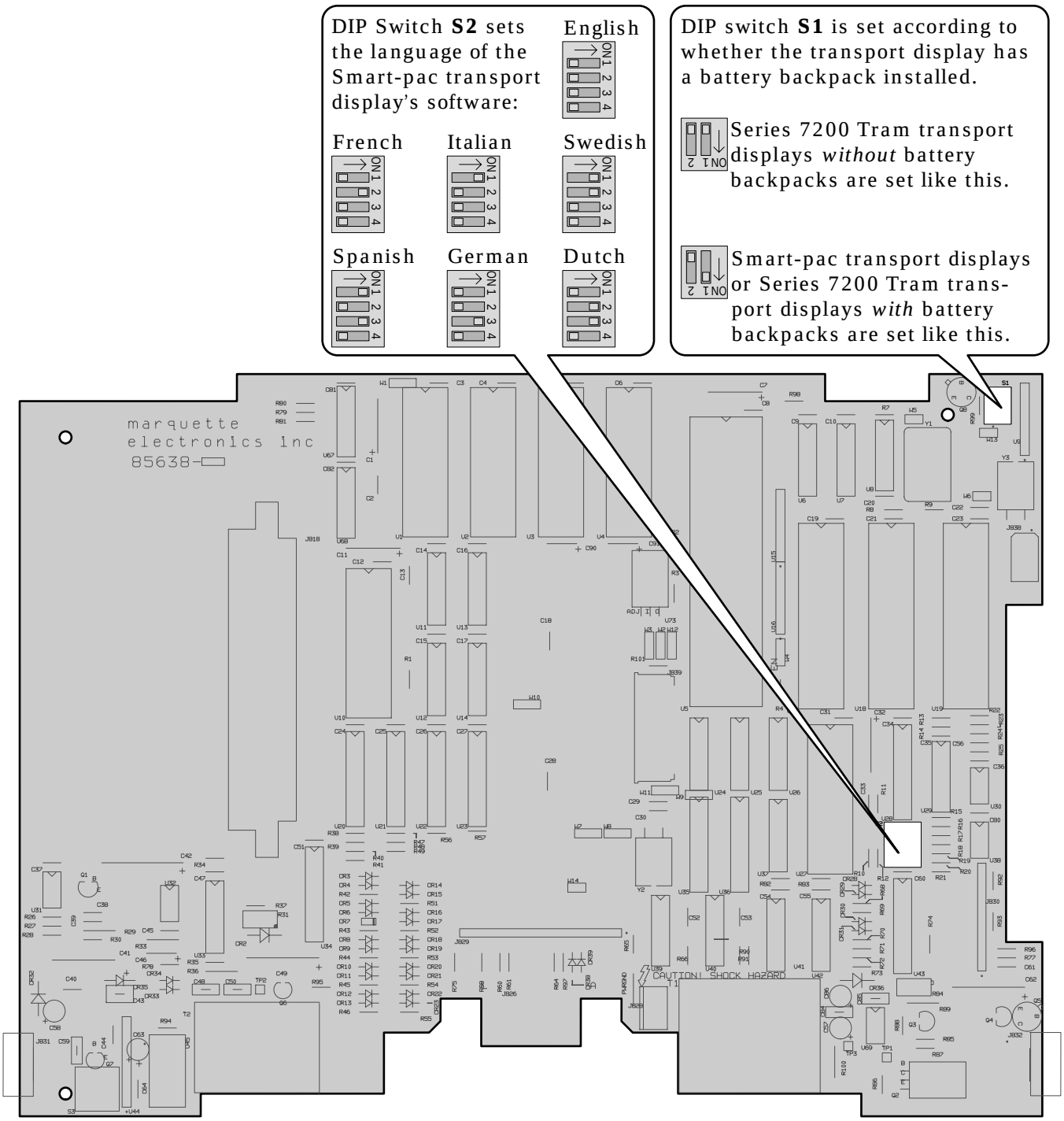
There are several jumpers on the display processor PCB. When you replace a display processor PCB, always make sure that the jumpers on the new circuit board are set correctly before you install the PCB. The figure below shows how to set the jumpers on the new circuit board.


Memory size jumper **W1** should be in the left position.
Watchdog reset enable jumper **W4** should be in the bottom (EN) position.
Processor/watchdog clock enable jumper **W5** should be installed.
DUART U19 clock enable jumpers **W6** and **W13** should both be installed.
Display controller U65 type jumper **W10** should be in the left position.
Display controller U65 clock select jumper **W14** should be installed.
Display controller U65 clock select jumper **W9** should be in the left position.
marquette
electronics inc
85638-
CAUTION! SHOCK HAZARD

→ Display Processor PCB PN 85638

Switch Settings

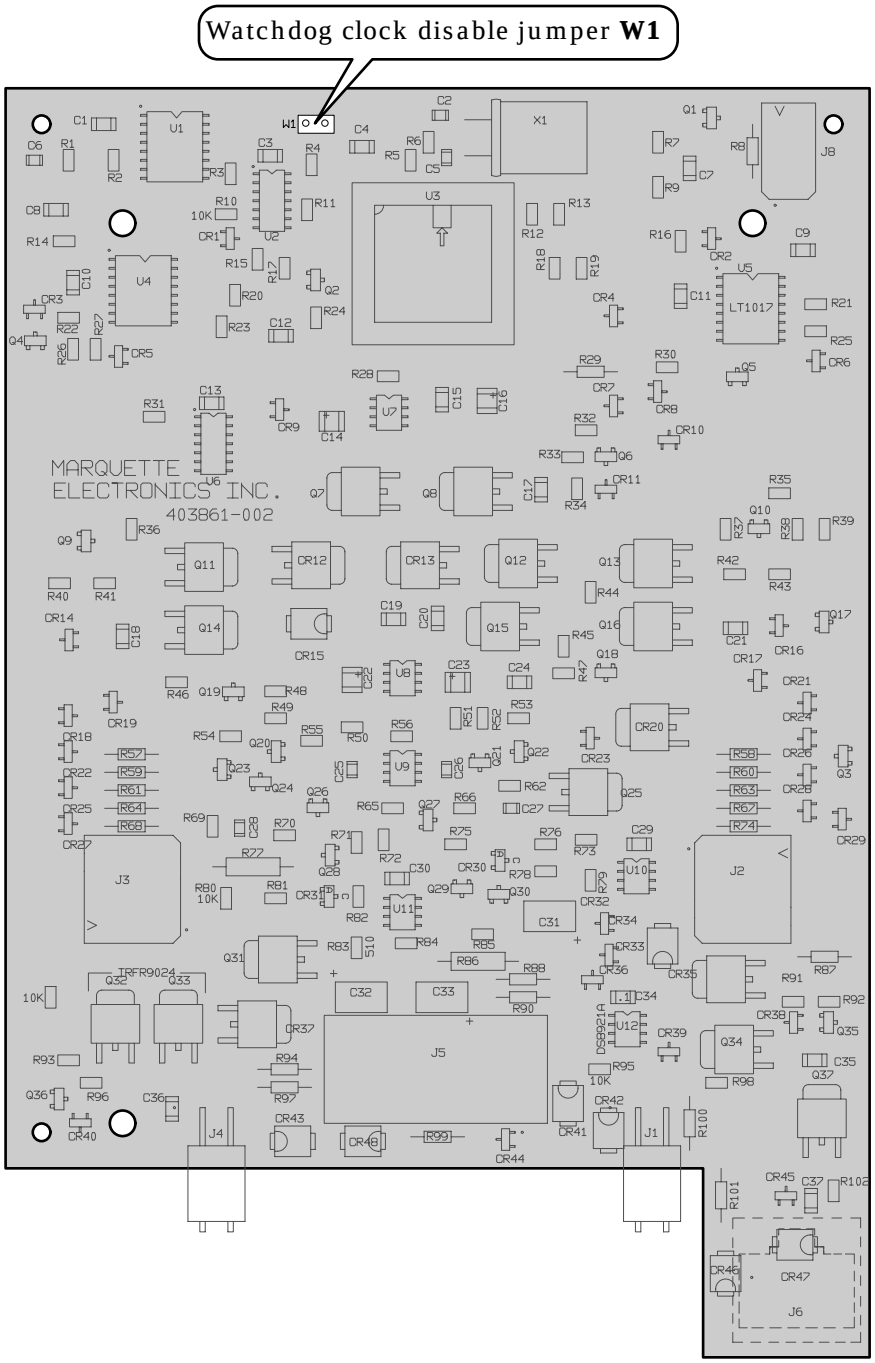
There are two sets of DIP switches on the display processor PCB. When you replace a display processor PCB, make sure that the switches on the new circuit board are correct. The figure below shows how to set the switches on a new circuit board.


DIP Switch **S2** sets the language of the Smart-pac transport display's software:
English
French
Italian
Swedish
Spanish
German
Dutch
DIP switch **S1** is set according to whether the transport display has a battery backpack installed.
Series 7200 Tram transport displays *without* battery backpacks are set like this.
Smart-pac transport displays or Series 7200 Tram transport displays *with* battery backpacks are set like this.
marquette
electronics inc
85638-
CAUTION! SHOCK HAZARD

Battery Interface PCB PN 403861

Jumper Setting

The battery interface PCB doesn't have any adjustments or switches, but it does have one jumper. The watchdog clock disable jumper, **W1**, should *not* be installed. If you replace a battery interface PCB, always make sure that the jumper on the new circuit board is not installed before you install the PCB.



For your notes

4 Preventive Maintenance

WHAT IS IN THIS CHAPTER?

This chapter contains preventive maintenance instructions for the Smart-pac transport display. These instructions describe how to care for your Smart-pac transport display and how to make sure that it's working properly.

Contents

Maintenance Schedule 4-2
Inspection 4-3
Cleaning 4-4
Check Procedure 4-5
Preventive Maintenance Inspection Form 4-13

Maintenance Schedule

The Smart-pac transport display maintenance schedule must include all of the items in this table.

What to do	When to do it
Inspection	Before you transport each patient.
Cleaning	Before you transport each patient.
Checkout procedures	When you first get your transport display, every six months thereafter, and when you remove or replace a circuit board.

WARNING

Failure on the part of the responsible individual, hospital, or institution employing the uses of this monitoring equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards. Marquette Medical Systems does not in any manner assume the responsibility for performing the recommended safety tests, unless an Equipment Maintenance Contract exists. The sole responsibility rests with the individual or institution using the equipment.

Inspection

You should inspect the Smart-pac transport display each time you transport a patient. Follow these guidelines when you inspect the display :

- Inspect the Smart-pac transport display for obvious physical damage and replace the damaged items.
- Inspect all connectors for bent pins or prongs. Qualified service personnel should replace the defective connectors.
- Inspect all cable insulation. Qualified service personnel should repair or replace damaged or deteriorated cables.

Cleaning

You should clean the Smart-pac transport display each time you transport a patient. You should clean the exterior surfaces with a lint-free cloth dampened with one of these approved solutions:

- Ammonia (diluted)
- Cidex
- Mild soap (dissolved)
- Sodium hypochlorite bleach (diluted)

CAUTION

Follow these cleaning instructions exactly. Failure to follow the instructions may melt, distort, or dull the finish of the case, blur lettering on the labels, or cause equipment failures.

Always dilute the solutions according to the manufacturer's suggestions.

Always wipe off all of the cleaning solution with a dry cloth after cleaning.

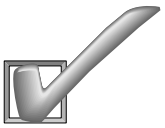
Never pour water or any cleaning solution on the equipment or permit fluids to run into the connectors or ventilation openings in the equipment.

Never use these cleaning agents:

- Abrasive cleaners or solvents of any kind
- Alcohol-based cleaning agents
- Wax containing a cleaning substance
- Acetone
- Betadine

Checkout Procedure

Getting Started



The following checkout procedures describe how to make sure the Smart-pac transport display operates correctly. Perform checkout procedures periodically and after you repair a transport display for proper operation.

You must use other equipment, like the Digital Display Writer (DDW) and Smart-pac power supply, in these checkout procedures. The checkout procedures listed here only fully test the Smart-pac transport display. You should also perform checkout procedures for the other equipment to make sure they operate. Refer to the checkout procedures in the appropriate service manuals.

Throughout this procedure you must connect the transport display to devices that you would use during normal operation. You may already have most of these items. The only exception is that you must connect to a **patient simulator** instead of a **real patient** to get waveforms and vital signs.

Required Special Equipment

You need the following items before you can start the procedures:

✓ A patient simulator. We use a Marquette Multifunction Micro-Simulator (pn MARQ-1) in the procedure, but you could use a different one. If you do, you need to change some of the steps slightly.

✓ A Tram module. We show a Tram 600A module in the procedure, but you can use any one of these:

- Series 7200 Tram module
- Series 7200 Tram AR module
- Tram 100, 200, 300, 500, or 600 module
- Tram 100-850 A or SL module

✓ An interconnection display cable. It goes between the Tram module and transport display. You can use any of these cables:

Part Number	Length (Feet)	Length (Meters)
403495-001	10	3.0
403496-001	15	4.6
406468-002	25	7.6
406468-001	40	12.2

✓ A patient cable to attach ECG leadwires to the Tram module.

- If you use a Tram module with a round ECG connector, you can use **pn 9443-001**.
- If you use a Tram module with a rectangular ECG connector, you can use **pn 403061-001**.

→

→ Checkout Procedures

→ Required Special Equipment

✓ A set of leadwires. Leadwires **pn 403066-005** are shown in this procedure.

✓ A blood pressure cable to connect the blood pressure output on the simulator to the input on the Tram module.

- If you use a Tram module with round BP connectors, you can use **pn 6770036**.
- If you use a Tram module with rectangular BP connectors, you can use **pn 700095-001**.

✓ A Direct Digital Writer (DDW). A Series 7160 DDW is shown in the procedure, but you can use a Series 7150 DDW as well.

✓ A DDW cable. The cable that you need depends on what kind of DDW you use:

- If you use a Series 7150 DDW, the DDW cable is the same type of cable that you use to connect the transport display to a Tram module, so you'll need one of these:

Part Number	Length (Feet)	Length (Meters)
403495-001	10	3.0
403496-001	15	4.6
406468-002	25	7.6
406468-001	40	12.2

- If you use a Series 7160 DDW, you need a **pn 700180-001** cable.

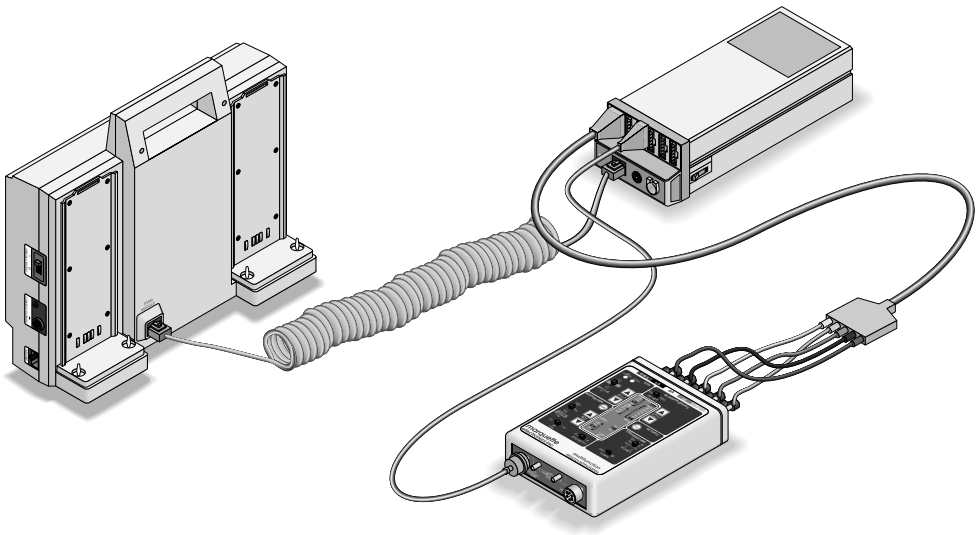
✓ A pair of power cables for the DDW and Smart-pac power supply.

→

→ Checkout Procedures

→ Procedure Steps

1. Set up the patient simulator to the following.
   - Set the heart rate to 80 BPM using the ECG SELECT ▲ and ▼ controls
   - Set the ECG amplitude switch to 1.0 mV
   - Set the blood pressure polarity switch to POS
   - Set the blood pressure output to 0 mmHg using the BLOOD PRESSURE OUTPUT ▲ and ▼ controls
2. Slide one fully-charged Smart-pac battery pack onto the back of the transport display.
3. Connect a cable between the DISPLAY connector on the Tram module and the TRAM MODULE connector on the rear of the transport display.
4. Attach a patient cable to the ECG connector on the Tram module.
5. Attach leadwires between the top of the patient simulator and the end of the patient cable.
6. Connect a cable between the patient simulator BLOOD PRESSURE 1 connector and the Tram module BP1 connector (pressure connector on the left).



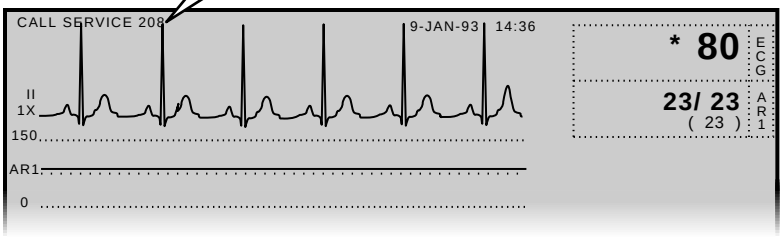
→

→ Checkout Procedures

→ Procedure Steps

7. Turn the transport display power switch *ON*.
8. Make sure the transport display turns on. You should see the screen backlight turn on and then the transport display prompts you to either continue monitoring or admit a patient.
9. Rotate the contrast control knob and observe changes in the screen contrast.
10. Rotate the Trim Knob control to highlight ADMIT PATIENT and then press the Trim Knob control to select it.
11. Make sure the transport display is not showing any CALL SERVICE messages.

CALL SERVICE Messages. When the Tram module powers up, it does a self test. If it passes the self test, you'll see the bed number and patient name in the upper left corner of the transport display's screen. If it fails one of the tests, the transport display shows a CALL SERVICE message here instead. The CALL SERVICE message means that your Tram module needs repairs. The service manual for your Tram module provides more information about these messages.



If the transport display shows a call service message, you should repair the Tram module and restart this procedure.

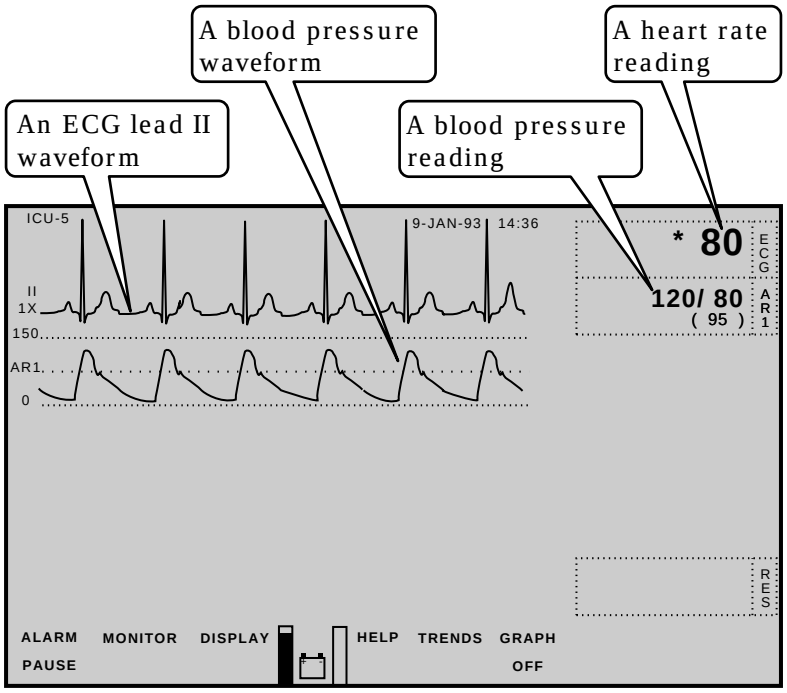
12. Press the BP ZERO key on the transport display front panel to zero the blood pressure channel.
13. Press the patient simulator's BLOOD PRESSURE OUTPUT ▼ control once to set its output to WAVE.

→

→ Checkout Procedures

→ Procedure Steps

14. Make sure the transport display's screen looks like the one in the figure below.



If your transport display shows some subtle differences, you should not be too concerned — you probably just have different software installed. Most important, the waveforms and readings should appear.

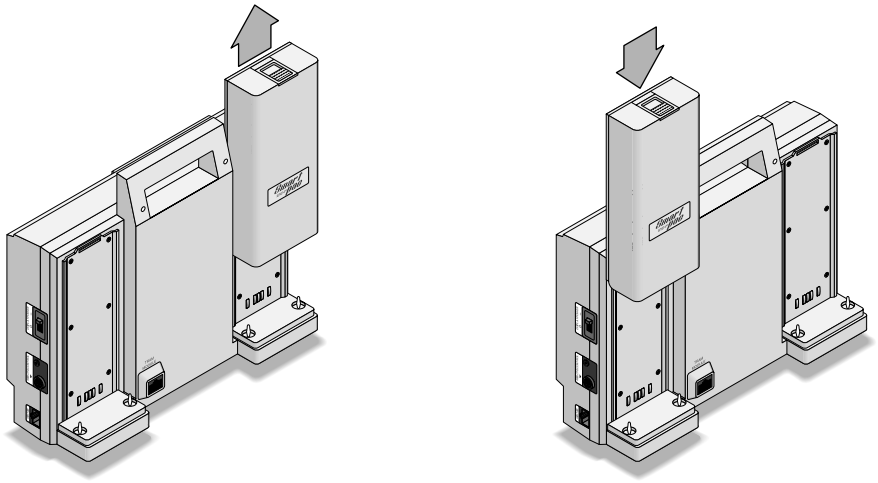
15. Press the FREEZE key on the transport display front panel.
16. Make sure the erase bar for the waveforms stops moving. The erase bar is the vertical line that moves across the screen from left to right and updates the waveforms.
17. Press the patient simulator's ECG SELECT ▲ control twice to select a 160-beat per minute heart rate.
18. Ensure the transport display shows approximately 160 for the heart rate value.
19. Ensure the transport display sounds an alarm.
20. Press the patient simulator's ECG SELECT ▼ control twice to select an 80-beat per minute heart rate again.
21. Press the ALARM RESET key on the transport display front panel.
22. Make sure the audible alarm stops.
23. Turn the transport display power switch *OFF*.

→

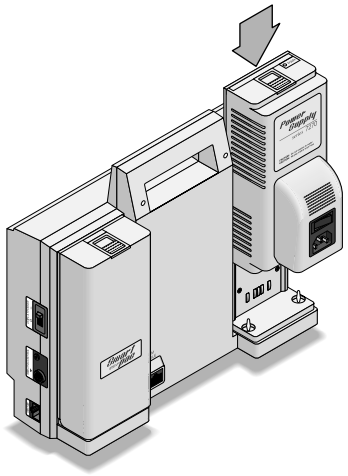
→ Checkout Procedures

→ Procedure Steps

24. Remove the battery pack from one side of the transport display and install it on the other side.



25. Turn the transport display power switch back *ON*.
26. Observe the battery status window to make sure the battery communicates with the transport display. (Select the battery icon on the screen and push the Trim Knob control to view the battery status.)
27. Make sure the transport display turns on again and shows the same waveforms that it did before you turned it off.
28. Install a Smart-pac power supply on the transport display, plug it into a power outlet, and turn it *ON*.



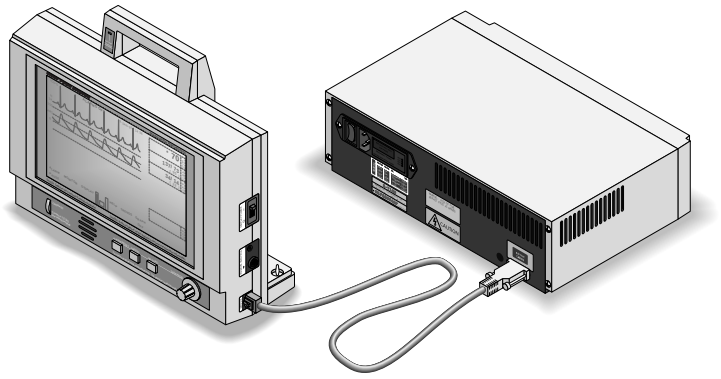
29. Make sure the BATTERY CHARGING light on the transport display handle turns *ON*.
30. Exchange the battery pack and and Smart-pac power supply and observe the battery status window charging in the other direction.
31. Make sure the BATTERY CHARGING light on the transport display handle turns ON again.

→

➔ Checkout Procedures

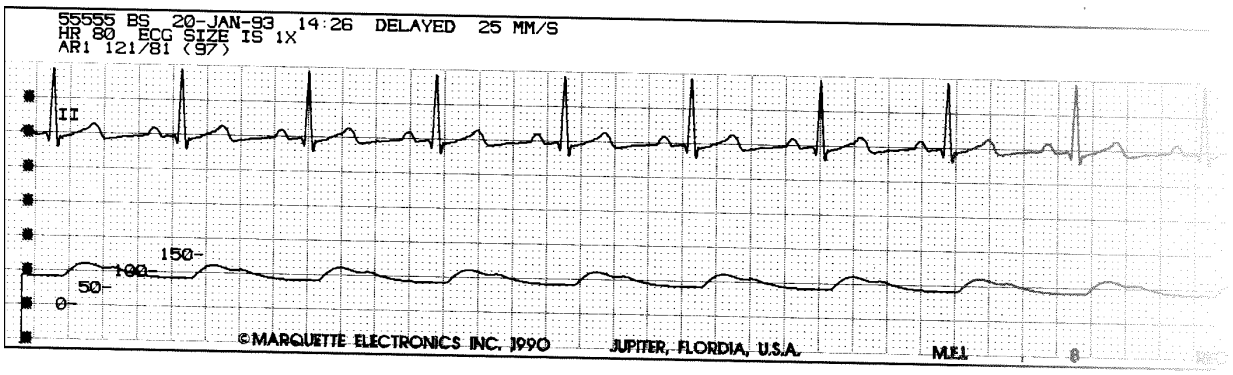
➔ Procedure Steps

32. Connect a Direct Digital Writer (DDW) to the transport display, plug it into a power outlet, and turn it *ON*.



33. Rotate the Trim Knob control to highlight GRAPH OFF. Then press the Trim Knob control to select it.

34. Make sure the DDW starts graphing.
35. Press the Trim Knob control to stop the graph.
36. Inspect the graph. It should look like this:



Completion

Remove all of the test cabling from the transport display.

- If the transport display passed the test, you may use it safely with patients.
- If the transport display **did not** pass the test, repair it and run this test again before you use it with patients.

Now would be a good time to do the checkout procedures for your other equipment, like the Tram module, Smart-pac power supply, and DDW. Refer to their service manuals for the correct procedures.

For your notes

Smart-pac Transport Display

MPMFRM-016
31 JUL 1995

Preventive Maintenance Inspection Form

(See Service Manuals p/n 403596-033 and 403596-036 for Details)

Customer _____ Customer Number _____ Date _____

FE _____ FE ID _____ Call Number _____

Backpack Serial Number _____ Software (Smartpack) Revision _____

7270 Power Supply Serial Number _____ Display Software Revision _____

Configuration

❑ Direct Digital Writer

Tools Required

Leakage tester	Multimeter	Marq1 simulator
Standard hand tools	Tram module	Interconnect cable
Patient Cable	Leadwires	BP Cable
Smartpac Battery		

Visual Inspection

Inspect the following for excess wear and /or any visual signs of damage

❑ General ❑ Connectors ❑ Cable insulation
❑ Reseat socketed components / connectors

Electrical Safety Tests

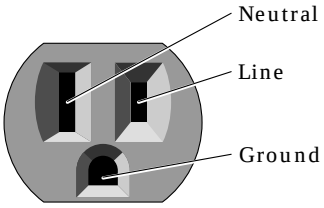
7270 Power Supply

Power outlet test

Line to Neutral (120V) ____V
Line to Ground (120V) ____V
Neutral to Ground (<3V) ____V

After outlet passes the above tests, check the neutral-ground loop resistance.

Neutral to ground (<2Ω)
____Ω



	Open		Closed	
	Normal	Reversed	Normal	Reversed
Ground-wire-leakage-current-to-ground test (<100µA)	____µA	____µA	N/A	N/A
Chassis-leakage-current-to-ground test (<100µA)	____µA	____µA	____µA	____µA

Operational Tests

Display

❑ Tram Comunications ❑ Contrast Knob ❑ Trim Knob
❑ Call Service Message ❑ BP Zero Key
❑ Freeze Key
❑ Audio Alarm ❑ Alarm Reset Key ❑ DDW Communication
❑ Off / On Switch

Battery A ❑ Power ❑ Communication ❑ Charging

Battery B ❑ Power ❑ Communication ❑ Charging

7270 Power Supply ❑ Output Voltage (16.75 Volts ±0.05V)

Comments

Please comment on any other environmental conditions (Static, Temperature, AC Power, Etc..) that may effect operation or reliability.

_____

_____

Briefly describe all repairs / adjustments made and list all parts replaced.

_____

_____

_____

_____

Customer Signature _____ FE Signature _____

5 Smart-pac Transport Display PN414189/900022

WHAT IS IN THIS CHAPTER?

This chapter describes the parts that make up a Smart-pac transport display with parts lists and exploded views. An earlier version of the upper level (pn 900022) is presented at the end of this chapter.

Contents

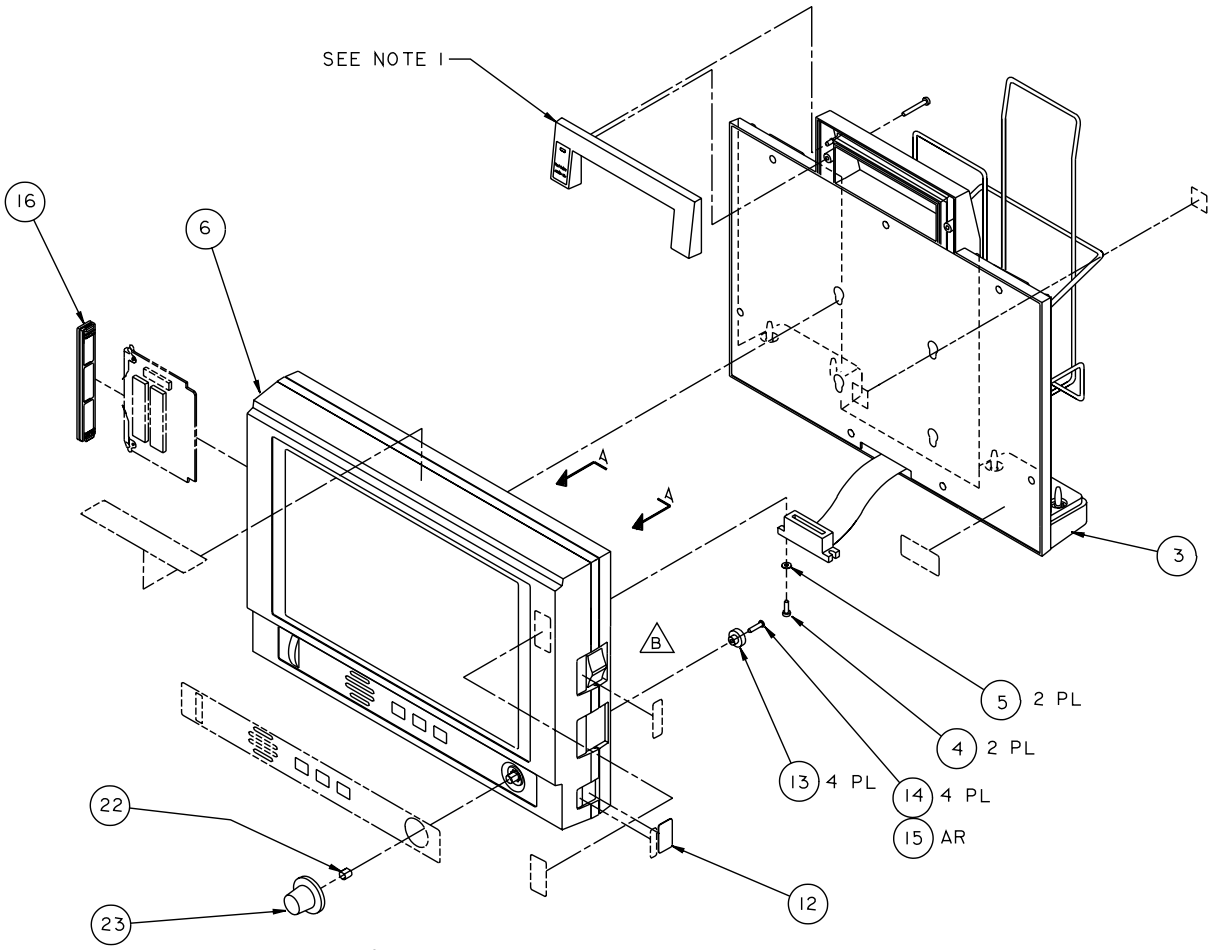
Parts List (PN 414189-001D) 5-2
Exploded View (PN 414189-001D) 5-3
Parts List (PN 900022-100C) 5-4
Exploded View (PN 900022-100C) 5-5

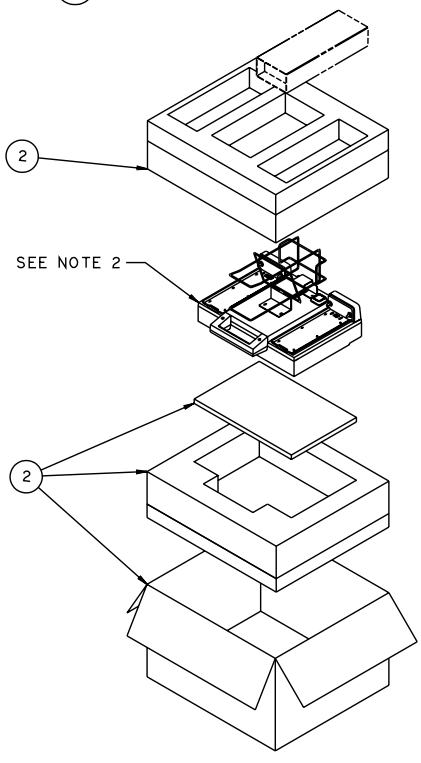
Parts List 414189-001D

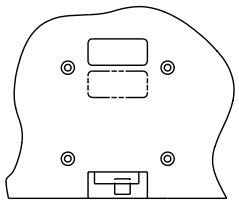
Item	Reference Designation	Description	Part Number	Qty
2		Carton, Shipping	404111-001	1
3		Display Assembly, Rear	402472-100	1
4		Screw, PNH, Phillips, SST, 4-40 *x* 5/16	4502-410	2
5		Washer, Lock, Internal Tooth, No. 4	4520-204	2
6		Transport Display Assembly[1]	413780-002	1
7		Interconnection Cable, Coiled (Not Shown)	403496-001	1
8		Bag, Anti-Static (Not Shown)	9976-005	1
9		*Smart-pac Transport Display Service Manual* (Not Shown)	403596-036	1
12		Connector Cover	404610-001	1
13		Button, Housing/Battery Backpack Mounting	402591-001	4
14		Screw, BDGH, Phillips, 4-40 *x* 3/8	4505-412	4
15		Adhesive, Loctite, Prism 460	4851-071	AR
16		Cover, Software Carriage	58126-001	1
22		Spring Clip, D-Type, 1/8-inch	4556-001	1
23		Knob, Rotary	58111-006	1

[1]See Chapter 6, “Transport Display Assembly,” for details.

Exploded View 414189-001D







VIEW AA

NOTES

1 REMOVE HANDLE FROM ITEM 2 IN ORDER TO ATTACH DISPLAY AND REASSEMBLE HANDLE

2 PACKAGE ASSEMBLY IN AN APPROVED ANTI-STATIC BAG

3 LOOSE ITEMS MAY BE SHIPPED WITH THE UNIT IF SPACE PERMITS OR PACKAGED AND SHIPPED SEPARATELY

6 ITEM 7 IS TO BE SHIPPED IN ITEM 8

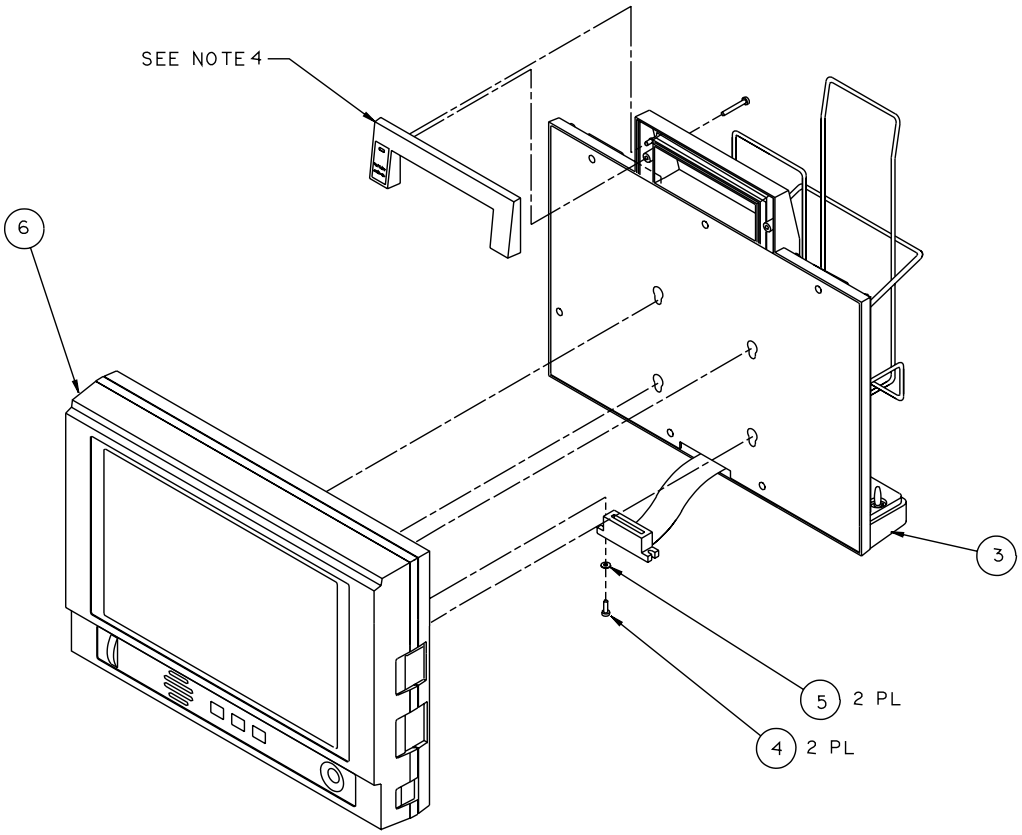
Parts List 900022-100C

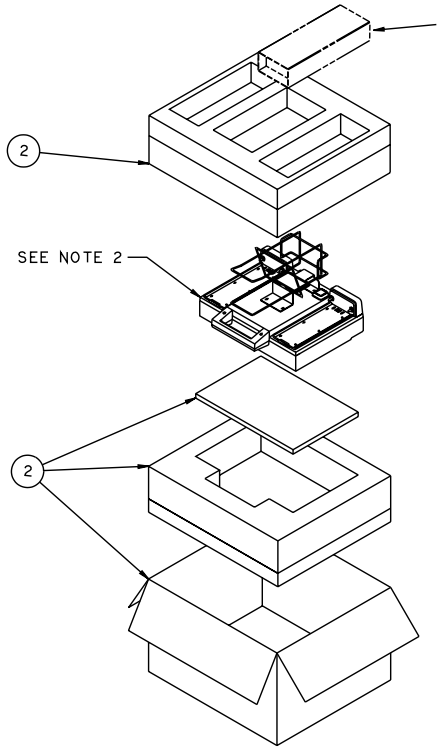
Item	Reference Designation	Description	Part Number	Qty
2		Carton, Shipping	404111-001	1
3		Display Assembly, Rear	402472-100	1
4		Screw, PNH, Phillips, SST, 4-40 *x* 5/16	4502-410	2
5		Washer, Lock, Internal Tooth, No. 4	4520-204	2
6		Transport Display Assembly[1]	404706-100	1
7		Interconnection Cable, Coiled (Not Shown)	403496-001	1
8		Bag, Anti-Static (Not Shown)	9976-005	1
9		*Smart-pac Transport Display Service Manual* (Not Shown)	403596-036	1

[1]See Chapter 6, “Transport Display Assembly,” for details

Exploded View

900022-100C





NOTES:
1) LOOSE ITEMS MAY BE SHIPPED WITH THE UNIT IF SPACE PERMITS OR PACKAGED AND SHIPPED SEPARATELY.

2) DISPLAY ASSY IS TO BE SHIPPED DISPLAY SIDE DOWN.

3) ITEM 7 IS TO BE SHIPPED IN ITEM 8.

4) REMOVE HANDLE FROM KIT ITEM 3 IN ORDER TO ATTACH DISPLAY AND REASSEMBLE HANDLE.

5) REFER TO PRODUCT LEVEL BILL OF MATERIAL FOR ACTUAL PART NUMBERS.

For your notes

6 Transport Display Assembly PN413780/404706

WHAT IS IN THIS CHAPTER?

This chapter describes the upper-level assembly of the Tram Transport Display assembly. The Tram Transport Display assembly is the front half of the Smart-pac Transport Display, which is everything except the battery backpack assembly described in Chapter 10.

This chapter lists the parts that make up the Tram Transport Display assembly and provides an exploded view to show you how they go together. **PN 413780-002** replaced the **-001** version and **pn 404706-100** version of this assembly. The older assemblies are included later in this chapter.

The Tram Transport Display assembly is a part of the Smart-pac Transport Display, which is described in Chapter 5, "Smart-pac Transport Display."

If the product code of the serial number is "LG" and product sequence number is 1 to 190 (except 186), it uses the **pn 413780-001** version of the flex circuit (item 59) and LCD display (item 34).

If the product code of the serial number is "LG" and product sequence number is 186, 191, or later, it uses the **pn 413780-002** version of the flex circuit (item 59) and LCD display (item 34).

Contents

Parts List (PN 413780-001D/002E) 6-2
Exploded View (PN 413780-001D/002E) 6-4
Revisions to the Assemblies 6-6
Parts List (PN 404706-100D) 6-7
Exploded View (PN 404706-100D) 6-8

Parts List 413780-001D/002F

Item	Reference Designation	Description	Part Number	Qty
1		Case Assembly	404704-001	1
3		Gasket, LCD Display (Mounts in a groove in the case assembly, item #1.)	414222-001	1
5		Bracket, Backpack Connector	58122-022	1
6		Knob, Contrast	58124-003	1
7		Filter, LCD Display (Install with non-glare surface facing outward)	58229-008	1
8	W4	Contrast Control Assembly	88774-006	1
12		Pad, Rubber, Bumper	411594-001	2
13		Spacer, Hex, 4-40 *x* 3/16	4658-408	2
14		Panel, Blank	58506-003	1
15		Nut, Keps, Hex, 6-32	4521-706	2
16	W8	Wire, 18 AWG, 5-inch (Green)	80234-121	1
17		Washer, Bellevile	4550-030	2
18	W2	Trim Knob Control Assembly	88773-002	1
19	SW1, W3	Power Switch Assembly	80774-001	1
20	A1	Display Processor PCB[1]	800814-001	1
21	A4, W5	Speaker Assembly	415042-001	1
24		Connector Cover	1885-903	1
25		Label, Blank	404525-001	1
26		Screw, Set, 6-32 *x* 1/8	4518-602	1
27		Insulator, Display Processor PCB	58262-002	1
28		Screw, BDGH, Phillips, 4-40 *x* 1/4	45074-408	10
29		Screw, BDGH, Phillips, 4-40 *x* 5/8	45074-420	6
30		Bracket, Trim Knob Control Mount	58125-001	1
31		Keypad Switch	58128-001	1
32		Keycap	57733-007	3
33	A2	Switch PCB[2]	85639-002	1
34	A3	LCD Display Assembly, 640 *x* 400 (for **PN 413780-001** only)	413687-001	1
		LCD Display Assembly, 640 *x* 400 (for **PN 413780-002** only)	413687-002	1
35	W6	Flex Circuit, Switch PCB	80698-001	1
37		Screen, Speaker	58417-001	1
41		Screw, PNH, Phillips, 4-40 *x* 3/16	45000-403	6
42		Washer, Flat, SST, No 4	4520-004	8
43		Label Set, Smart-pac Display	414176-001	1
44		Gasket Set, Shock Mounting	403404-002	1
45	E1, E2	Splice But, Insulated, 26-22 AWG	4533-005	2
48		Adhesive, Loctite, Prism 460	4851-071	AR
51	J5	Connector w/Locks, 3-pin	1885-103	1
52	W7, W11	Wire, 22 AWG (White)	4899-001	1
57		Bracket, Smart-pac Display, Right	413786-001	1
58		Bracket, Smart-pac Display, Left	413787-001	1
59	W1	Flex Circuit, Display Processor PCB (for **PN 413780-001** only)	413943-001	1
		Flex Circuit, Display Processor PCB (for **PN 413780-002** only)	413943-002	1
60		Screw, PNH, Phillips, 4-40 *x* 3/16	45000-405	10
62		Clamp, Smart-pac Display w/Choke Mount	414306-002	1
63		Clamp, Smart-pac Display, Center	414307-001	1
64		Foam Pad	415041-001	1

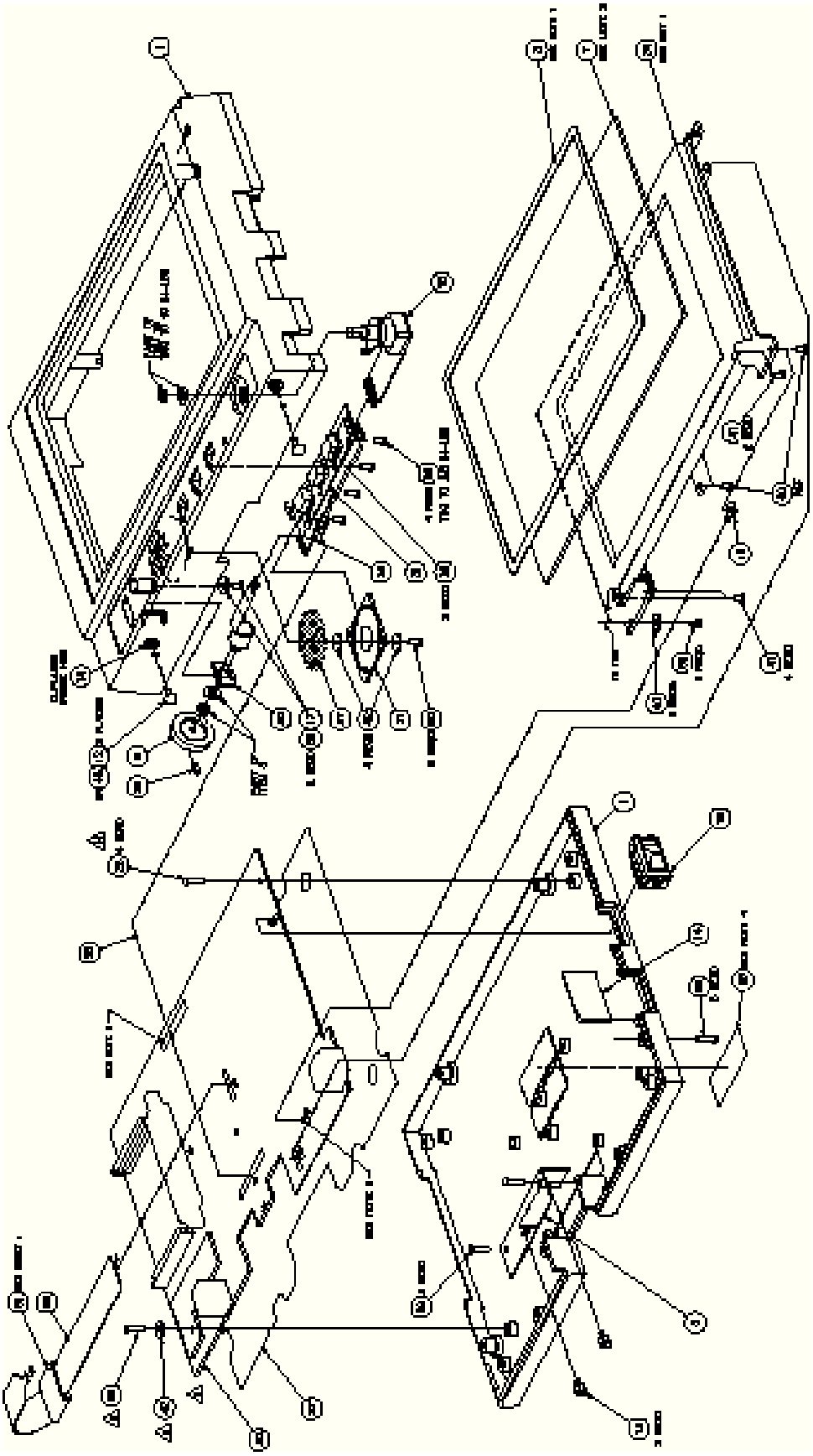
→

→ Parts List 413780-001D/002F

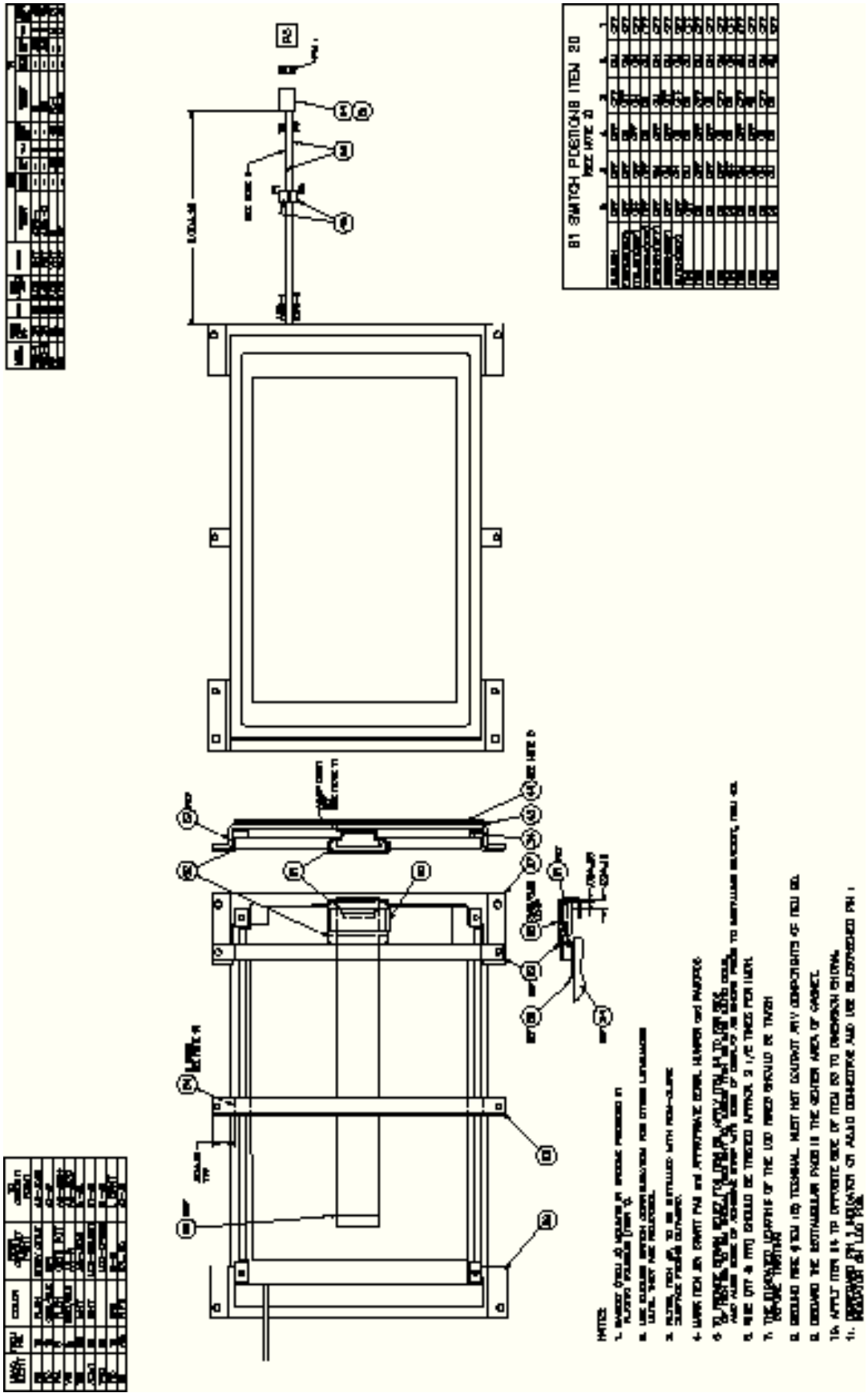
Item	Reference Designation	Description	Part Number	Qty
65		Tape, Kapton	4835-001	AR
81		Ferrite Bead	416092-003	1
82		Screw, BDGH, Phillips, 4-40 *x* 1/2	45074-416	1

[1]See Chapter 7, “Display Processor PCB,” for details.
[2]See Chapter 8, “Switch PCB,” for details.

Exploded View (Sheet 1 of 2) 413780-001D/002F



Exploded View (Sheet 2 of 2) 413780-001D/002F



Revisions to the Assemblies

The baseline revision for this PCB is pn 413780-001D. To convert the parts list back to a previous version, change all part numbers, descriptions, and quantities as indicated in the Revision History table below.

An older version of the display processor assembly (PN 85638-006) is provided after this page.

PN 413780-001 Revision History

Revision	Item	Description	Revision's Part Number	Qty	Baseline Part Number	Qty
A		Initial Production Release				
B	42	Washer, Flat, SST, No. 4	Not Used		4520-004	4
C	21	Speaker Assembly (A4, A5)	80776-001	1	415042-001	1
	42	Washer, Flat, SST, No. 4	4520-004	4	4520-004	8
		Bracket, Tram Speaker	58941-001	2	Deleted	0
	60	Screw, PNH, Phillips, 4-40 *x* 3/16	45000-405	12	45000-405	10
	64	Foam Pad, Speaker	4616-001	1	415041-001	1
D		Documentation Change Only				

PN 413780-002 Revision History

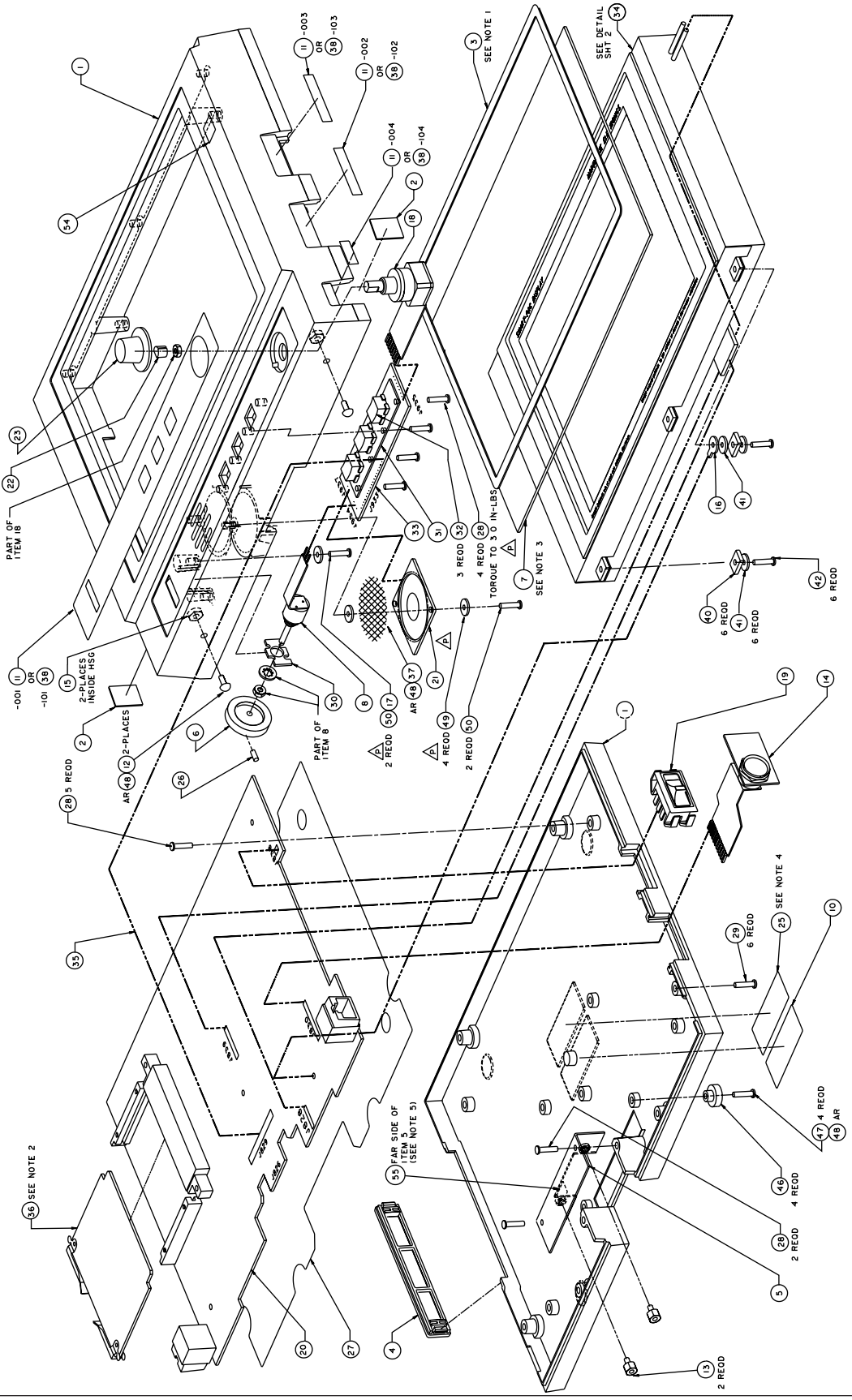
Revision	Item	Description	Revision's Part Number	Qty	Baseline Part Number	Qty
A		Initial Production Release				
B	65	Tape Kapton, 1/2 Wide	416176-001	1	4835-001	1
C	62	Clamp, Smart-pac Display	414306-001	1	414306-002	1
	81	Ferrite Bead	Not Used		416092-003	1
D		Connector Cover	404610-001	1	Deleted	0
		Cover, Software Cartridge	58126-001	1	Deleted	0
		Button, Housing	402591-001	1	Deleted	0
		Screw, BDGH, Phillips, 4-40 *x* 3/8	45074-412	1	Deleted	0
E	41	Screw, PNH, Phillips, 4-40 *x* 3/16	45000-403	8	45000-403	6
	60	Screw, PNH, Phillips, 4-40 *x* 3/16	45000-405	8	45000-405	10
F	82	Screw, BDGH, Phillips, 4-40 *x* 1/2	Not Used		45074-416	1
	28	Screw, BDGH, Phillips, 4-40 *x* 1/4	45074-408	11	45074-408	10

Parts List 404706-100D

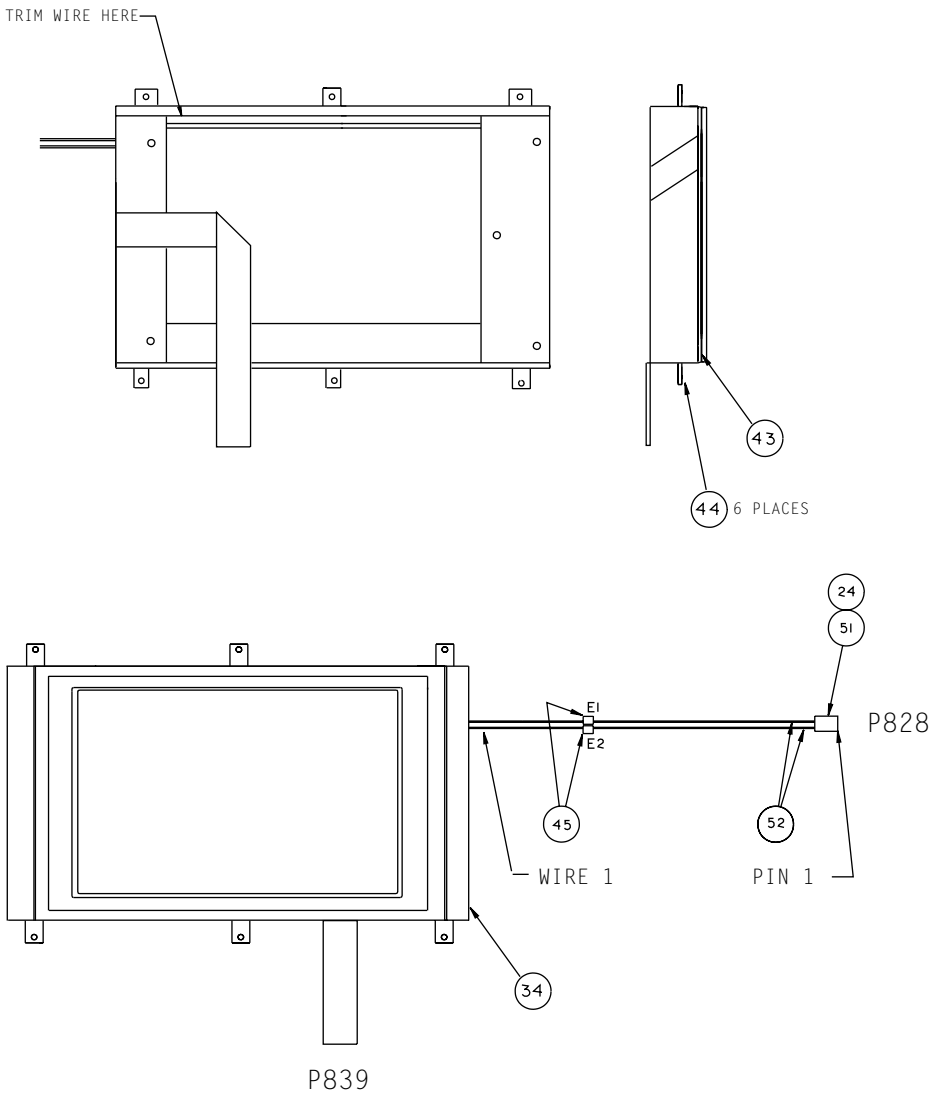
Item	Reference Designation	Description	Part Number	Qty
1		Case Assembly	404704-001	1
2		Connector Cover	404610-001	2
3		Gasket, LCD Display (Mounts in a groove in the case assembly, item #1.)	58123-002	1
4		Cover, Software Cartridge	58126-001	1
5		Bracket, Backpack Connector	58122-002	1
6		Knob, Contrast	58124-003	1
7		Filter, LCD Display (install with non-glare surface facing outward.)	58229-008	1
8	W4	Contrast Control Assembly	88774-006	1
9		Software Cartridge Assembly, English (used on PN 404706-001 and -008 only.)	88775-016	1
10		Label, Caution	70206-003	1
11		Label Set, Smart-pac Display, English (used on PN 404706-001 and -009 only.)	404687-000	1
12		Bumper, 0.43 Dia., >5 Lg., 6-32 Thd	411594-001	2
13		Spacer, Hex, 4-40 *x* 3/16	4658-408	2
14	W1	Remote Control Connector Assembly	80764-002	1
16	W8	Wire, 18 AWG, 5-inch (Green)	80234-121	1
17		Washer, Bellevile	4550-030	2
18	W2	Trim Knob Control Assembly	88773-002	1
19	SW1,W3	Power Switch Assembly	80774-001	1
20	A1	Display Processor PCB[1]	85638-006	1
21	W5	Speaker Assembly, 1.5-inch square, 8 Ohm	415042-001	1
22		Spring Clip, D-Type, 1/8-inch	4556-001	1
23		Knob, Trim Knob Control	58111-006	1
25		Label	404525-001	1
26		Screw, Set, 6-32 *x* 1/8	4518-602	1
27		Insulator, Display Processor PCB	58262-002	1
28		Screw, BDGH, Phillips, 4-40 *x* 1/4	45074-408	13
29		Screw, BDGH, Phillips, 4-40 *x* 5/8	45074-420	6
30		Bracket, Contrast Control	58125-001	1
31		Keypad Buttons	58128-001	1
32		Keycap	57733-007	3
33	A2	Switch PCB[2]	85639-002	1
34	W7	LCD Display Assembly, 640 x 400, Black, Foreign (**Not used** on **PN 404706-001** and **-008**)	404705-002	1
35	W6	Flex Circuit, Switch PCB	80698-001	1
36		Software Cartridge Assembly, Foreign (**Not used** on **PN 404706-001**)	88775-014	1
37		Screen, Speaker	58417-001	1
38		Label Set, Smart-pac Display, Icon (**Not used** on **PN 404706-001** and **-009**)	404687-100	1
39	W7	LCD Display Assembly, Domestic (used on **PN 404706-001** only)	404705-002	1
40		Pad, Shock Mount	58652-001	6
41		Washer, Flat, Brass, No. 6	4520-706	7
42		Screw, PNH, Phillips, 4-40 *x* 1/2	45000-408	6
46		Button, Housing/Battery Backpack Mounting	402591-001	4
47		Screw, BDGH, Phillips, 4-40 *x* 3/8	45074-412	4
48		Adhesive, Loctite Prism 460	4851-071	AR
49		Washer, Flat Stainless Steele, No. 4	4520-004	4
50		Screw, SEMS, Phillips, 4-40 *x* 5/16	45000-405	4

[1]See Chapter 7, “Display Processor PCB,” for details. [2]See Chapter 8, “Switch PCB,” for details.

Exploded View (Sheet 1 of 2) 404706-100D



Exploded View (Sheet 2 of 2) 404706-100D



GENERAL NOTES:

1. GASKET (ITEM 3) MOUNTS IN GROOVE PROVIDED IN PLASTIC HOUSING (ITEM 1).
2. USE ENGLISH SWITCH CONFIGURATION FOR OTHER LANGUAGES UNTIL THEY ARE RELEASED.
3. FILTER, ITEM #7, TO BE INSTALLED WITH NON-GLARE SURFACE FACING OUTWARD.
4. MARK ITEM 25: SMART PAC AND APPROPRIATE SERIAL NUMBER AND BARCODE.
5. ON GERMAN UNITS,MARK LABEL, ITEM 55, AS FOLLOWS: ZULASSUNGSKENNZEICHEN: 01/M-273/93.

For your notes

7 Processor Display PCB PN800814/85638

WHAT IS IN THIS CHAPTER?

This chapter describes the display processor PCB. This assembly contains all of the active electronic circuitry in the transport display assembly, so it does many jobs. These jobs include:

- communicating with a Tram module to collect patient data
- reading user input from the switch PCB
- driving the LCD display
- sending patient data to a DDW so it can be graphed
- reading battery status information from the battery interface PCB in the battery backpack assembly, so that it can display how much battery power is in each Smart-pac battery pack

An older version of the display processor assembly, pn 85638-006 is also provided at the end of this chapter. For both assemblies, this chapter presents the parts that make up the display processor PCB, and provides parts location and schematic diagrams for this circuit board.

The display processor PCB is a part of the transport display assembly. For more information about that assembly, refer to Chapter 6: “Transport Display Assembly.”

Contents

Parts List (PN 800814-001D) 7-2
Parts List (PN 801446-001A) 7-4
Parts Location Diagram (PN 800814-001D) 7-5
Parts Location Diagram (PN 801446-001A) 7-8
Schematic Diagram (PN SD800814-001D) 7-9
Schematic Diagram (PN 801446-001A) 7-16
Theory of Operation for PN 800814 7-17
List of Inputs and Outputs 7-22
Revisions to the Assemblies 7-26
Parts List (PN 85638-006C) 7-27
Parts Location Diagram (PN 85638-006C) 7-30
Schematic Diagram (PN SD85638-006A) 7-32

Parts List 800814-001D

Reference Designation	Description	Part Number	Qty
C1	Cap, Cer, 0.001µF, 5%, 50V, SM	1153-824	1
C2, 10, 14, 21	Cap, Tant, 10µF, 20%, 25V, SM	1152-106	4
C3, 4, 7, 8	Cap, Cer, 10pF, 5%, 50V, SM	1181-100	4
C5, 6	Cap, Tant, 1.0µF, 10%, 35V, SM	403907-001	1
C9	Cap, Tant, 4.7µF, 20%, 20V, SM	402004-001	1
C11	Cap, Cer, 0.033 µF, 5%, 50V, SM	1182-333	1
C12, 13, 16, 17, 19, 20	Cap, Tant, 22µF, 10%, 25V, SM	407653-001	6
C15	Cap, Cer, 0.047µF, 5%, 50V, SM	1182-824	1
C18	Cap, Al Radial, 470uF, 20%, 25V	1259-471	1
C100 - 154, 156 - 164	Cap, Cer, 0.1µF, 20%, 50V	404370-001	64
CR1, 2	Diode, Schottky, SM BAT54	401985-001	2
CR3	Diode, Transient Voltage Suppression, SM P6SMB20AT1	403939-001	1
CR4	Diode, Transient Voltage Suppressor, 5V, 600W P6SMB6.8AT1	403189-001	1
J1	Connector, PC Header, 60-Pin	17021-030	1
J2	Connector, Single Row, 18-Pin	1848-318	1
J3	Socket, Receptable, 8-Pin	17023-002	1
J5	Connector W/Locks, PC Header, 3-Pin	1850-103	1
J6	Connector, Header, 20-Pin	17054-001	1
J7	Connector, PC Header, 2-Pin	412751-001	1
Q1, 3, 5, 7	Transistor, NPN, SM T3904	2511-001	4
Q2	Transistor, PNP, SM T2907A	405759-001	1
Q4	Transistor, NPN, SM MMBT6428L	404304-001	1
Q6, 8	Transistor, PNP, SM T3906	2511-101	2
R1, 2, 6, 7, 14, 21, 30, 34, 36, 37, 38, 41, 48, 49, 71	Res, Cer, 10K, 1%, 1/8W, SM	1082-104	15
R3, 4, 9, 13, 15, 16, 18, 19, 20, 22, 26, 50	Res, Cer, 1K, 1%, 1/8W, SM	1082-103	12
R5, 8, 17	Res, Cer, 100K, 1%, 1/8W, SM	1082-100	3
R10, 11	Res, Cer, 2.49K, 1%, 1/8W, SM	1082-771	2
R12, 52, 53	Res, Cer, 49.9 Ω, 1%, 1/8W, SM	1082-799	3
R23	Res, Cer, 180 Ω, 5%, 1/8W, SM	1081-496	1
R24, R31	Res, Cer, 4.99K, 1%, 1/8W, SM	1082-101	2
R27, 29, 39, 70, 72	Res, Cer, 20K, 1%, 1/8W, SM	1082-202	5
R28	Res, Cer, 499K, 1%, 1/8W, SM	1082-499	1
R32	Res, Var, 2K, Side Adjust, SM	409023-003	1
R33	Res, Cer, 49.9K, 1%, 1/8W, SM	1082-498	1
R35, 42, 43, 44, 46, 47	Res, Cer, 100Ω, 1%, 1/8W, SM	1082-755	6
R40	Res, Cer, 2K, 1%, 1/8W, SM	1082-201	1
R45	Res, Cer, 10Ω, 1%, 1/8W, SM	1082-786	1
R51	Res, Cer, 8.45K, 1%, 1/8W, SM	1082-812	1
SW1	Switch, Dual In-Line, 6-Station, SM	401960-001	1

→

→ Parts List 800814-001D

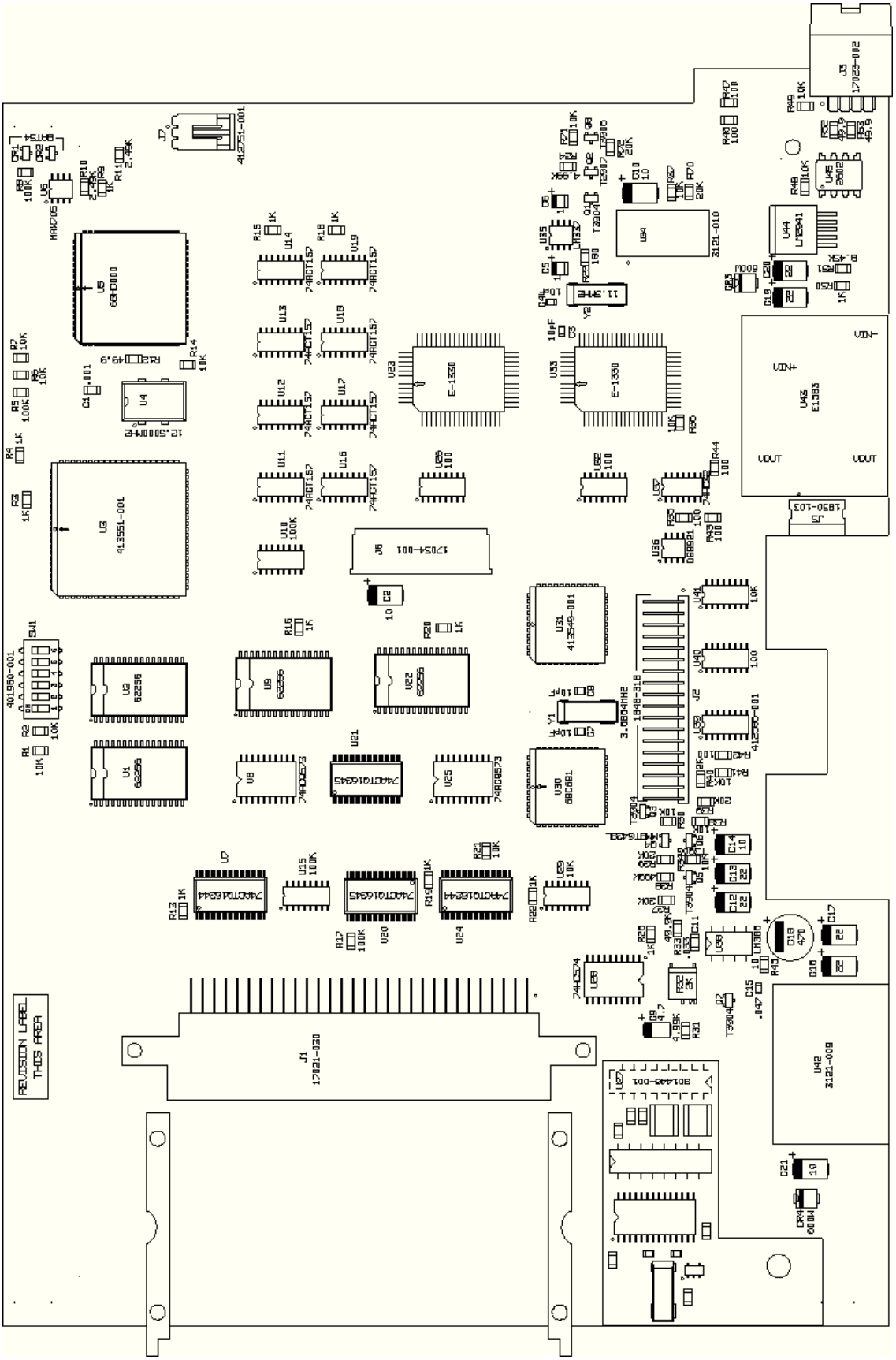
Reference Designation	Description	Part Number	Qty
U1, 2, 9, 22	RAM, Static, 32K x 8-Bit , SM 62256FLP	3202-256	4
U3	EPLD, Programmed, Address Decoder	413551-001	1
U4	Oscillator, CMOS, 12.5000MHz, SM	401480-002	1
U5	Microprocessor, 12.5MHz, SM 68HC00	401343-001	1
U6	Volt Rgltr MAX705	410066-001	1
U7, 24	Buffer/Line Driver, Octal, SM ACTQ16244	410522-001	2
U8, 25	Latch, Type D, Three-State Output, Octal, SM ACQ573	408741-001	2
U10, 15	Res Ntwk, 100K, SM	1061-104	2
U11 - 14, U16 - 19	Flip Flop, Positive-Edge-Triggered, Type D, Dual, SM ACT74	401433-001	8
U20, 21	Transceiver, Bus, Octal ACTQ16245	410523-001	2
U23, 33	Display Controller, SM E-1330BA	3215-002	2
U26, 32, 40	Res Ntwk, 100Ω	1062-101	3
U27	Sound Generator PCB[1]	801446-001A	1
U28	Flip-Flop, Type D, Three-State Output, Octal, SM HC574	402654-001	1
U29, 41	Res Ntwk, 10K	1062-103	2
U30	Asynchronous Receiver/Transmitter, Dual, PLCC 68C681	3015-602	1
U31	EPLD, Programmed, Video RAM Arbitrator	413549-001	1
U34	Power Converter, 5V-to-12V, 750mW	3121-010	1
U35	Volt Rgltr LM337LM	411709-001	1
U36	Line Driver/Receiver, Differential, SM DS8921AM	404013-001	1
U37	OR Gate, 2-Input, Quad , SM HC32	3038-032	1
U38	Power Ampl, Audio LM386N	3102-386	1
U39	Diode Pair Array, ESD/Overvoltage Protection, SM	412586-001	1
U42	Power Converter, 9V-to-16V, 500 mA	3121-009	1
U43	Power Inverter, 12V Input E1583	413641-001	1
U44	Volt Rgltr, Adj LM2941	403609-002	1
U45	Isolator, Optically-Coupled, SM 2602	407164-001	1
Y1	Crystal, 3.6864MHz, SM	408828-001	1
Y2	Crystal, 11.5MHz, SM	408828-002	1
–	Adhesive, RTV-162	4851-049	AR
–	Circuit Board	800815-001A	1
–	Guide, Software Cartridge	58129-001	2
–	Schematic Diagram	SD800814-001A	1
–	Screw, BDGH, Phillips, 4-40 x 3/16	45074-406	4

[1]See the next page for the Parts List.

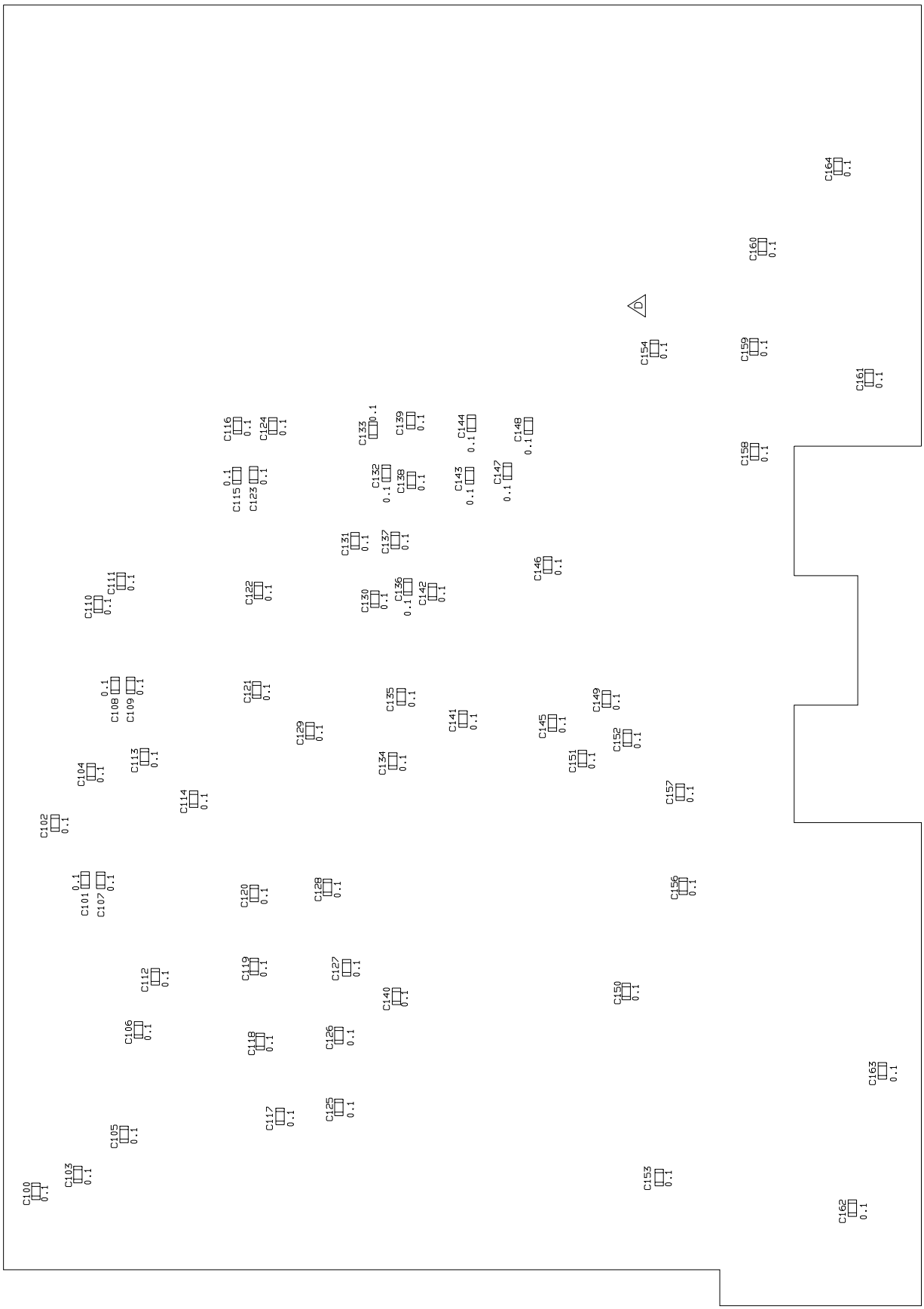
Parts List 801446-001A

Reference Designation	Description	Part Number	Qty
C1, 3, 5	Cap, Cer, 0.1µF, 20%, 50V, SM	404370-001	3
C2, 4	Cap, NPO, 33pF, 5%, 50V, SM	411576-004	2
C6, 7	Cap, Cer, 1.0µF, 5%, 50V, SM	1182-105	2
J1	Connector, DIP, 16-pin	419911-001	1
R1	Res, Cer, 1K, 1%, 1/16W, SM	410334-008	1
R2	Res, 150Ω, 1%, 1/16W, SM	410334-028	1
R3	Res, 100Ω, 1%, 1/16W, SM	410334-003	1
TL1	Standoff, PCB, SS, 3.6ID *x* 4mm lg	420073-001	1
U1	Micro-controller, Programmed, Smart-pac, V.1A	420132-001	1
U2	Inverter, CMOS, SM, TC7S04C	3046-004	1
U3	Sound Generator, 3-Channel, YMZ284	413704-001	1
Y1	Crystal, 16.00-MHz, SM	415598-001	1
—	Circuit Board	801447-001A	1
—	Schematic Diagram	SD801446-001A	1

Parts Location Diagram (Sheet 1 of 3) 800814-001D



→ Parts Location Diagram (Sheet 2 of 3) 800814-001D

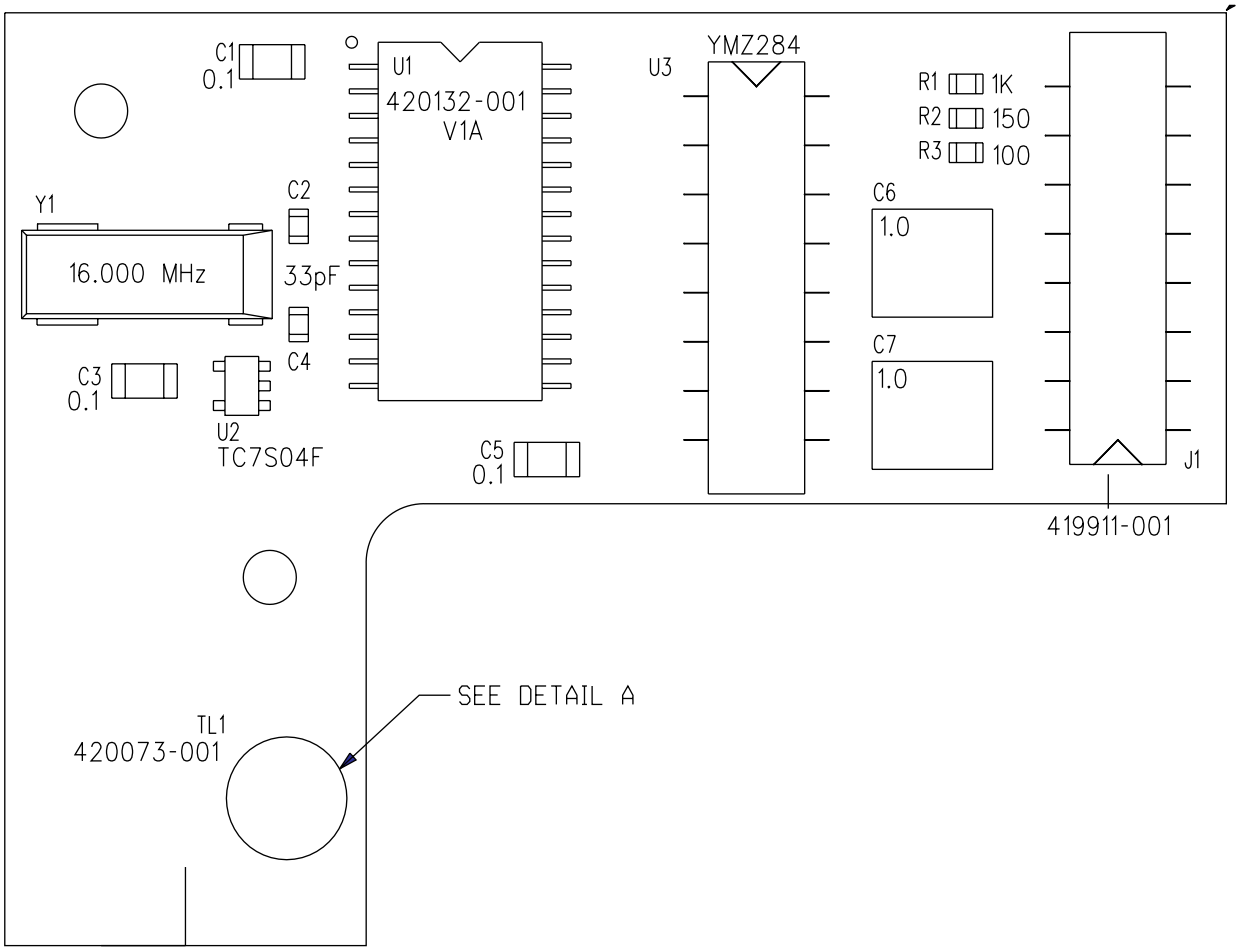


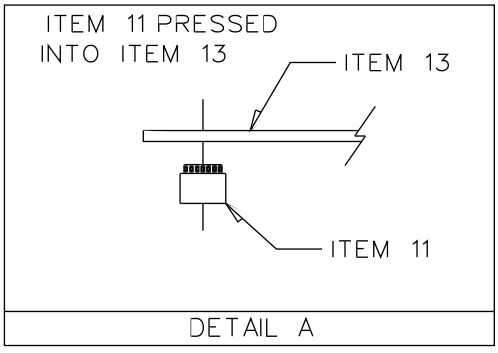
→ Parts Location Diagram (Sheet 3 of 3) 800814-001D

NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN MICROFARADS.
2. THE BAR SHOWN ON ALL POLARIZED CAPACITORS DENOTES POSITIVE TERMINAL.
3. U1, U2, U9, U22 ARE TO BE PLACED ON THE LOWER 28 PINS OF THE FOOTPRINT AS SHOWN.
4. TRIM PINS AND PLASTIC POSTS ON J3 AFTER SOLDERING.
5. PUT A DROP OF RTV (ITEM 78) UNDER U42 (ITEM 36) IN THE CENTER BEFORE INSTALLATION.
6. THE FOLLOWING COMPONENTS APPEAR ON THE SILKSCREEN BUT ARE NOT USED ON THIS ASSEMBLY: R25 AND C155.

Parts Location Diagram 801446-001B

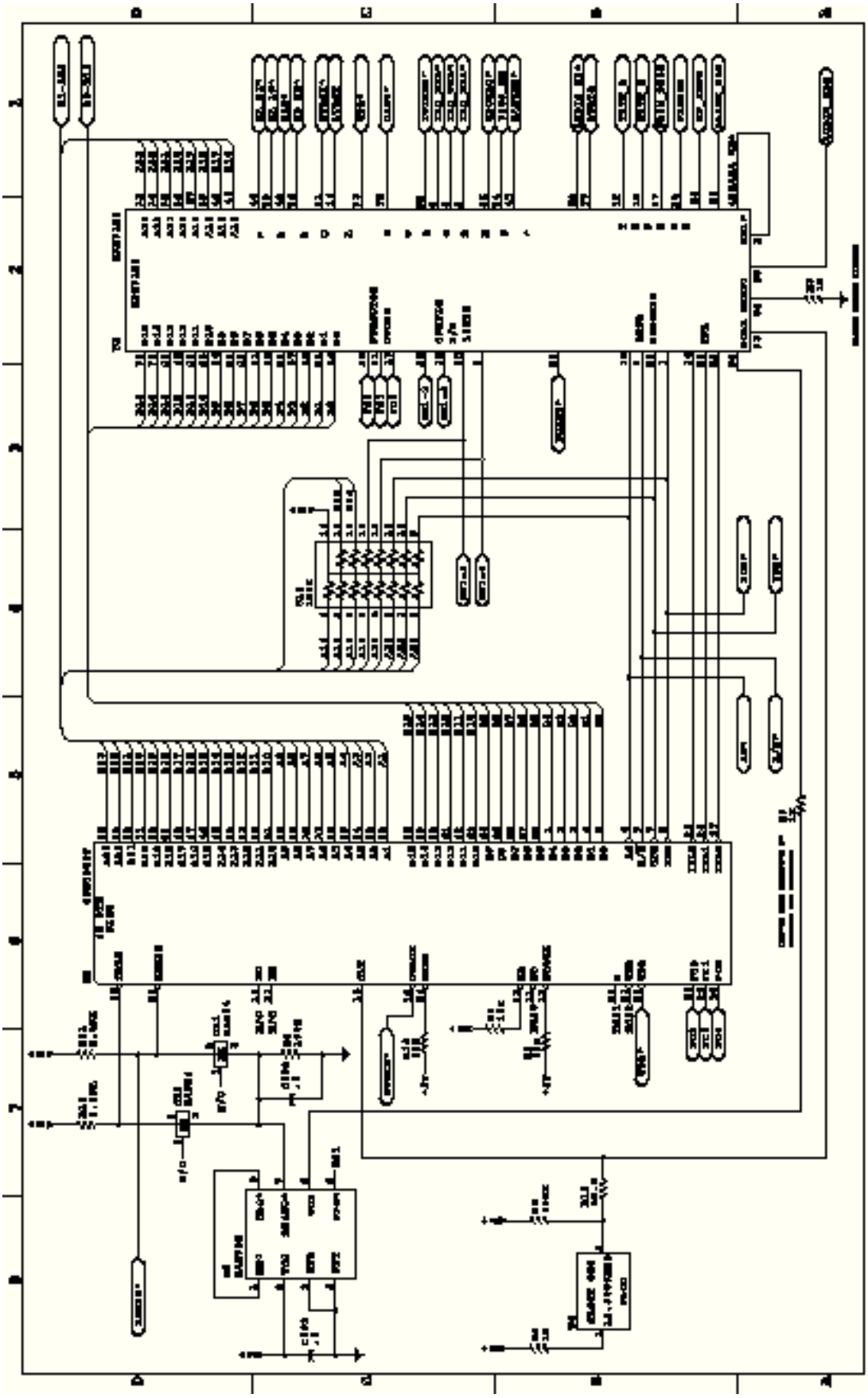




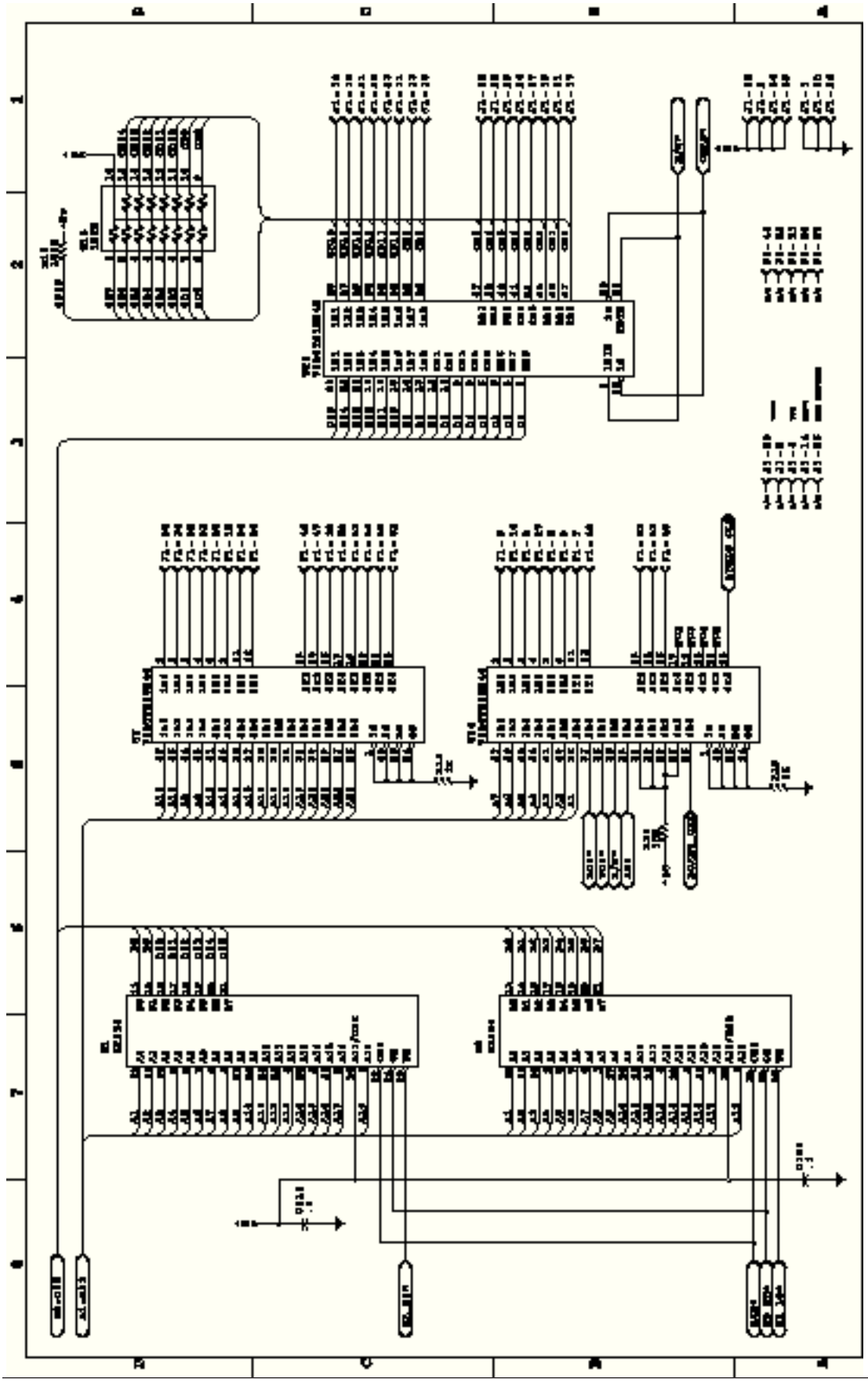
NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN MICROFARADS.
2. THE BAR SHOWN ON ALL POLARIZED CAPACITORS DENOTES POSITIVE TERMINAL.

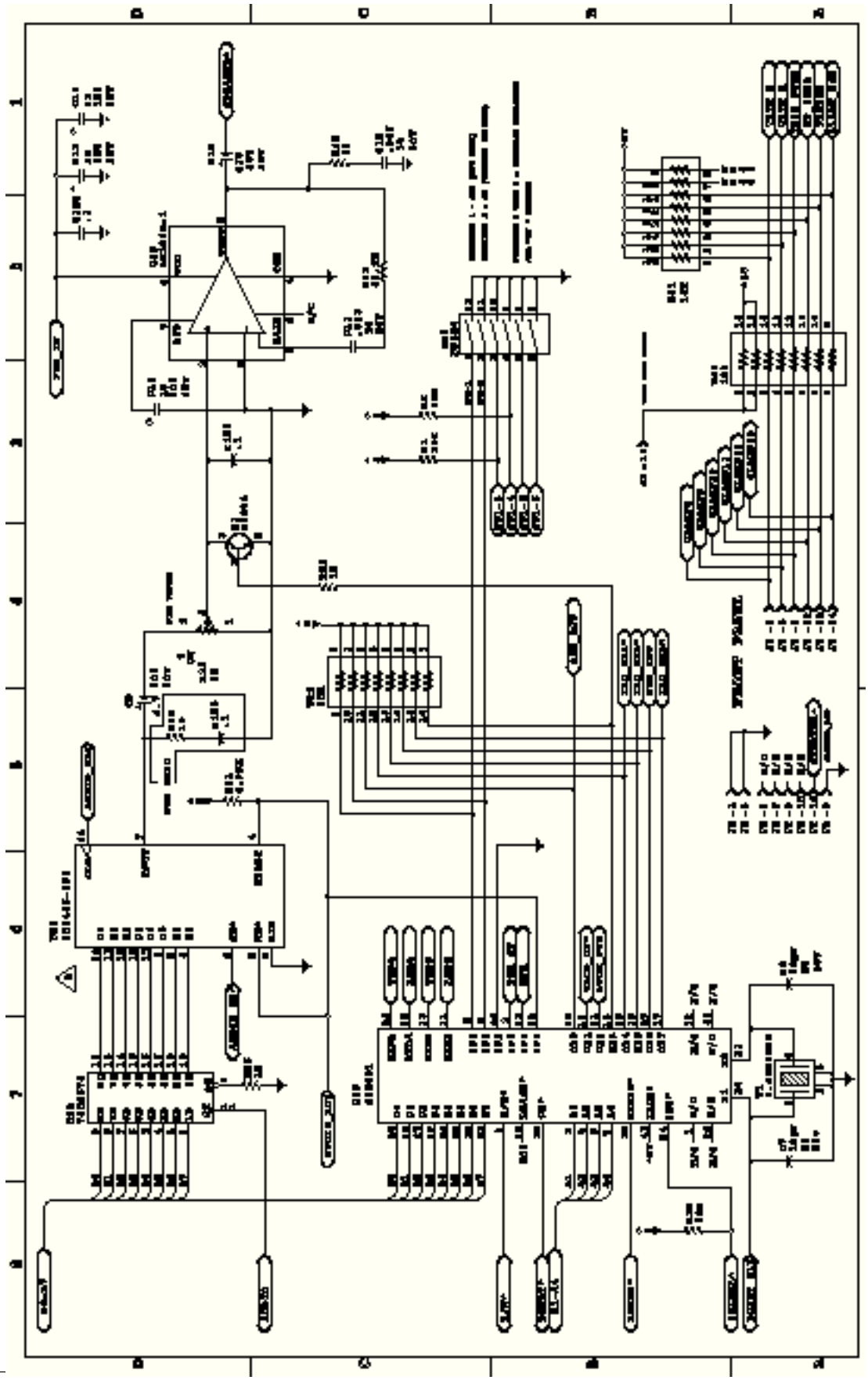
Schematic Diagram (Sheet 1 of 7) SD800814-001B



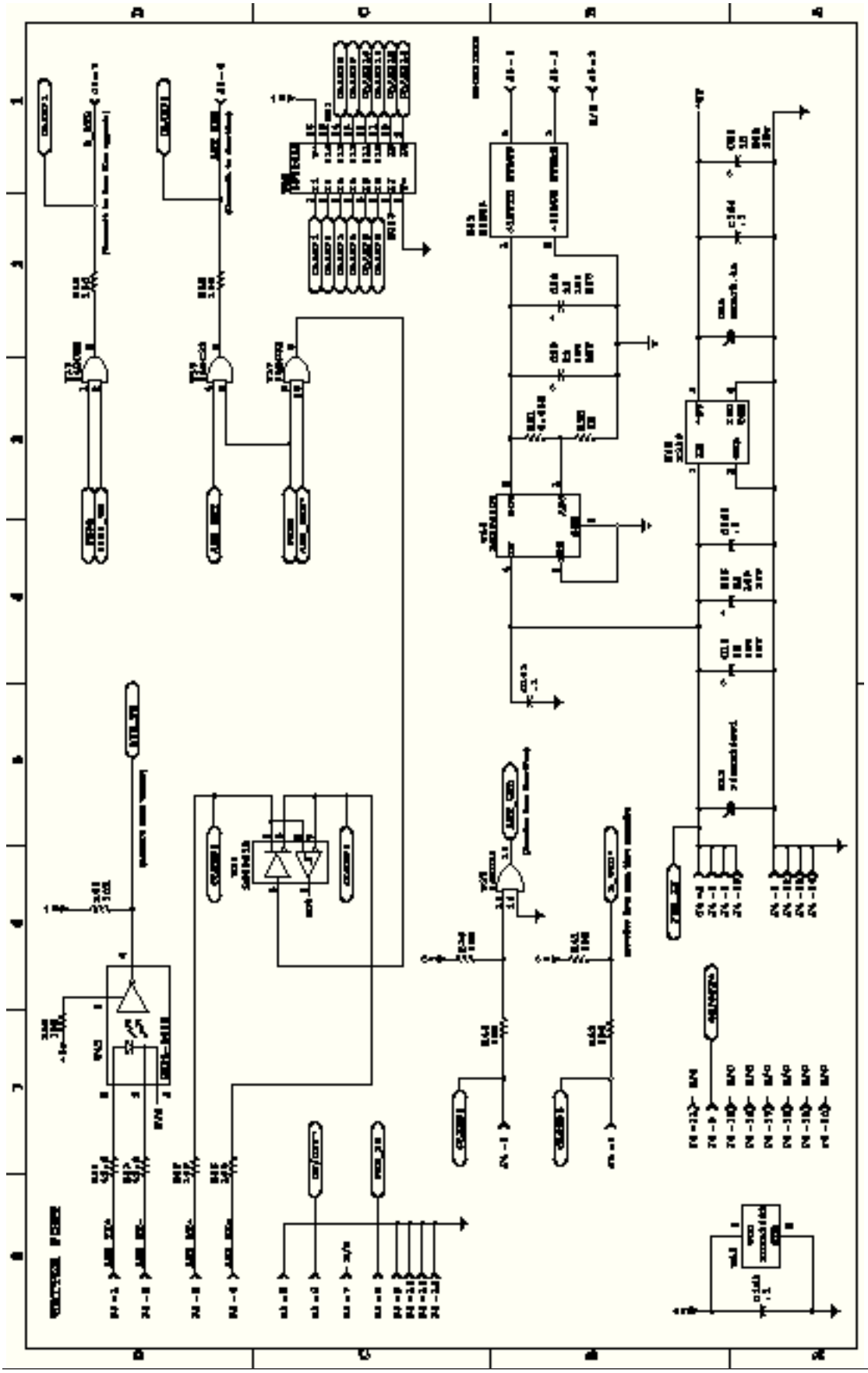
Schematic Diagram (Sheet 2 of 7) SD800814-001B



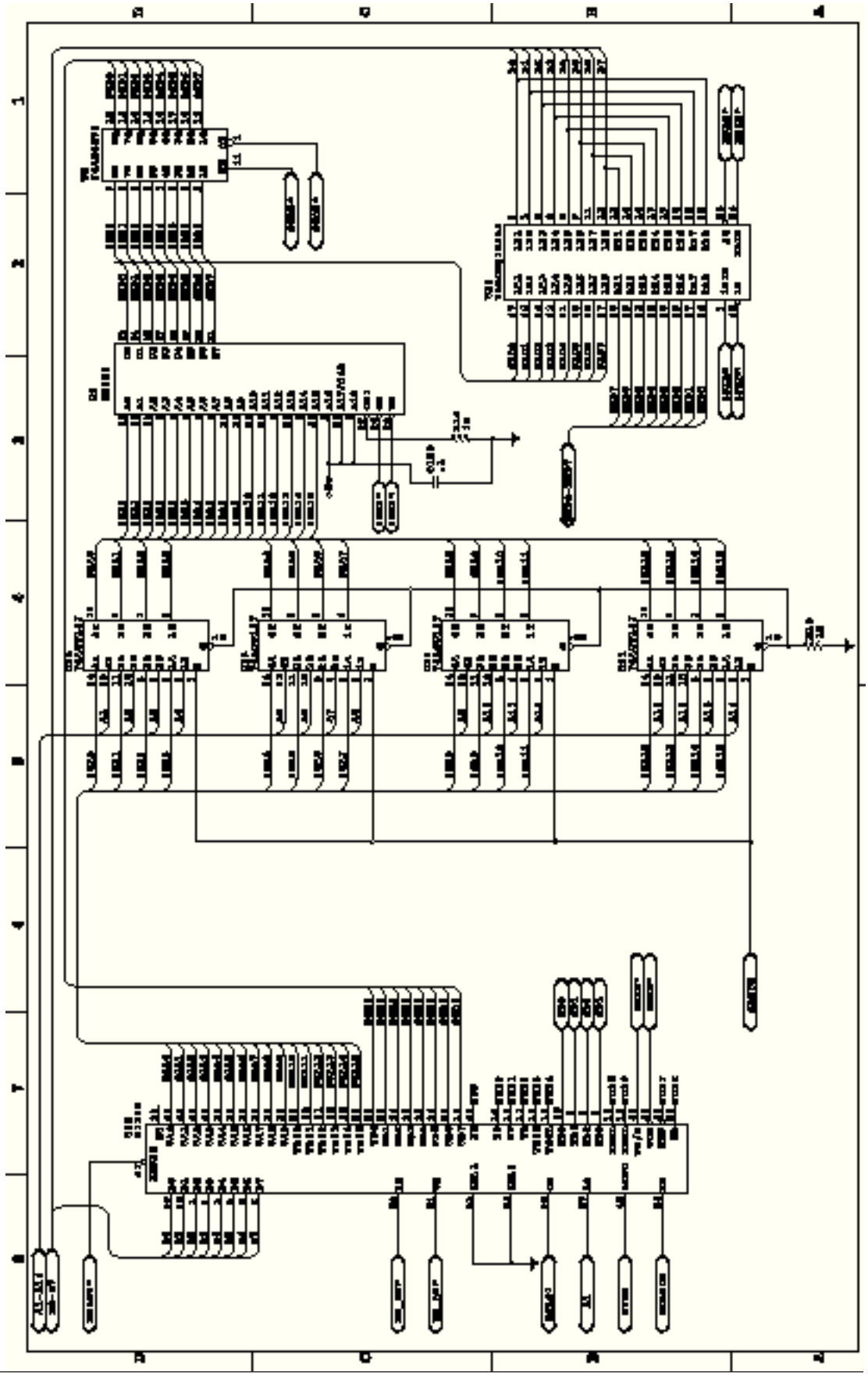
Schematic Diagram (Sheet 3 of 7) SD800814-001B



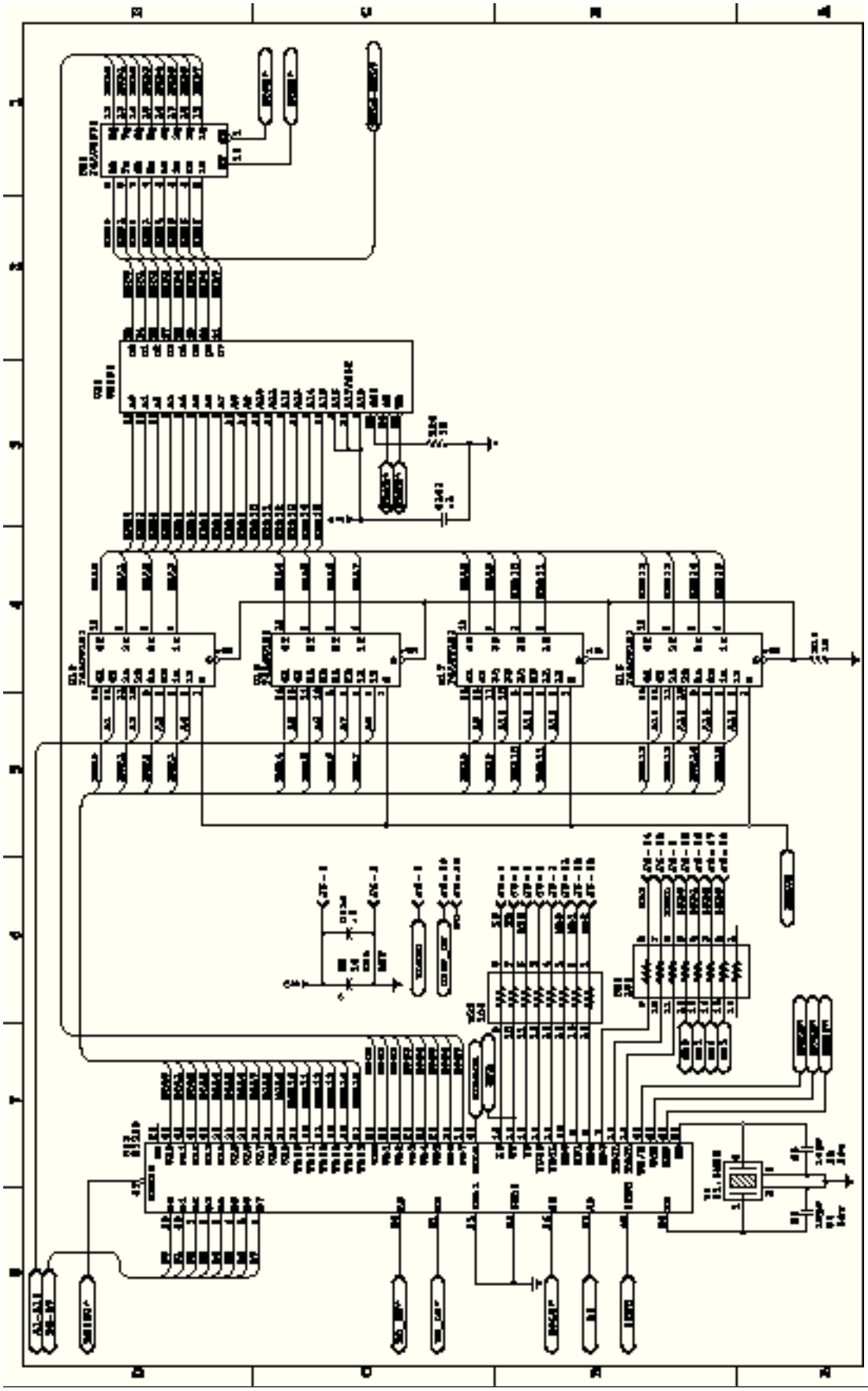
Schematic Diagram (Sheet 4 of 7) SD800814-001B



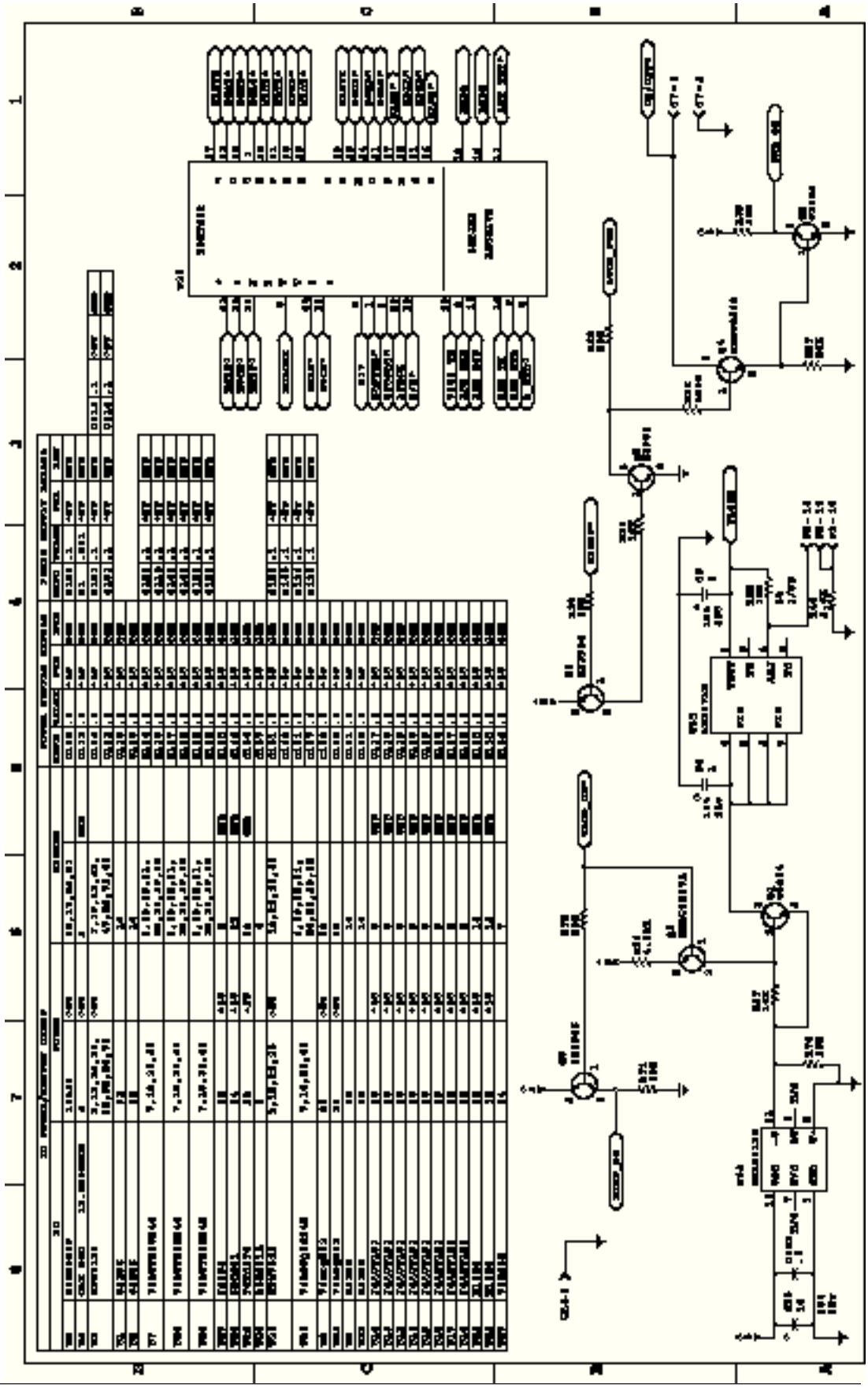
Schematic Diagram (Sheet 5 of 7) SD800814-001B



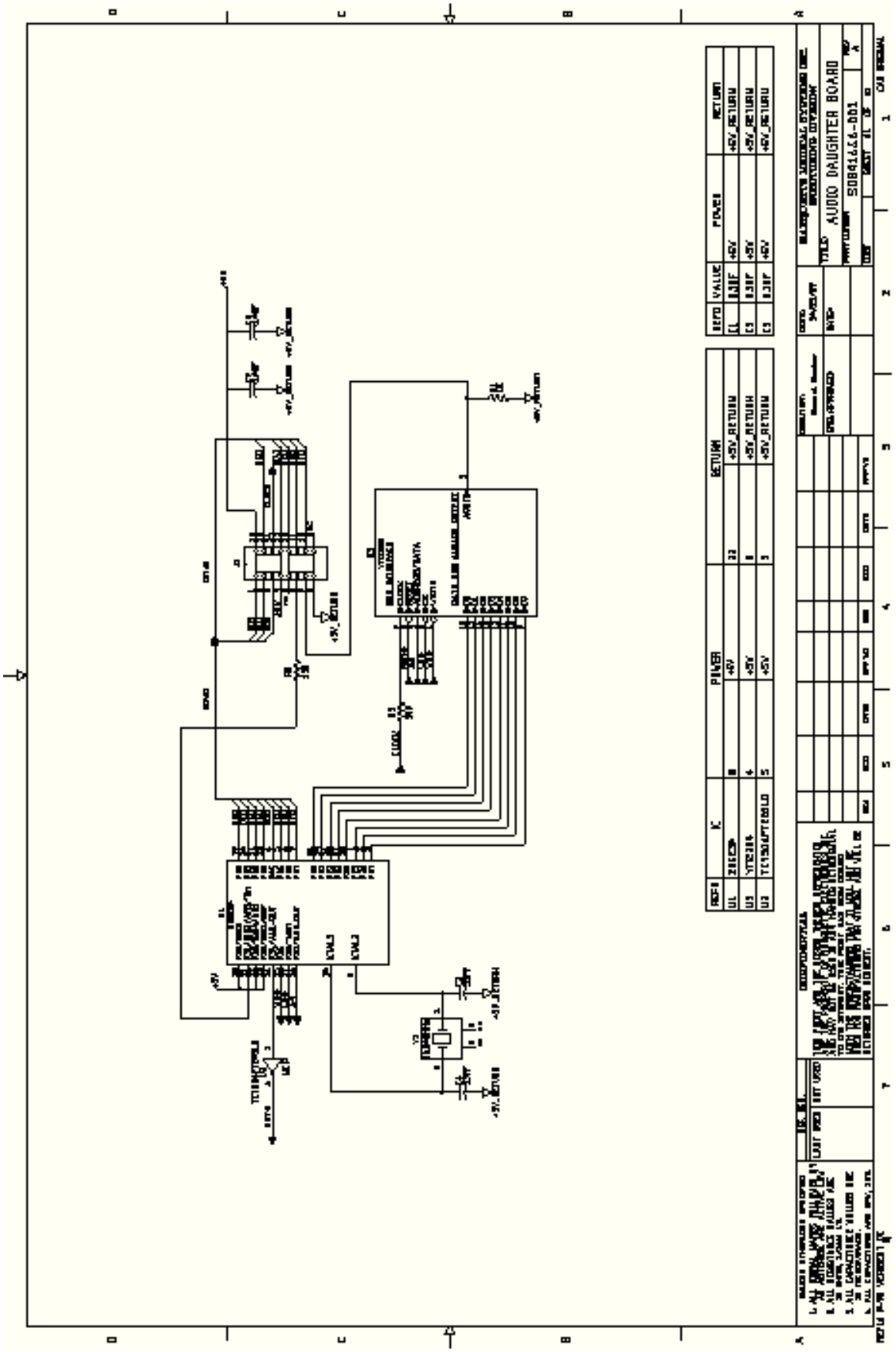
Schematic Diagram (Sheet 6 of 7) SD800814-001B



Schematic Diagram (Sheet 7 of 7) SD800814-001B



Schematic Diagram SD801446-001A



Theory of Operation for PN800814

Overview

All functions on the display processor PCB are controlled by microprocessor U5 with a clock rate of 12.5MHz set by oscillator U4. Resistor R4 enables the oscillator output while R5 pulls the output high when the oscillator is disabled. System application code is stored in EPROM memory on a separate plug in cartridge. The cartridge is interfaced with buffers U7 and U24 providing a buffered address bus and U20 as a bi-directional data bus buffer. The 100K pullup resistors simply provide a logic high when the output buffer is in the high impedance state. 64K of static RAM (U1, U2) resides on the board for system workspace. Custom logic is contained in EPLD U3 with all address decoding and processor support logic. DUART U30 controls all of the serial communication and reads the system configuration switches.

All audio functions are performed either by a programmable sound generator U27 or by sound generator PCB pn 801446-001 with an audio power amplifier U38 providing appropriate drive levels to the off board speaker assembly.

The video circuit is controlled by a pair of display controllers U23 and U33 each drives half of the LCD screen. Video arbitration, address decoding and serial port selection functions are performed by the programmed EPLD video RAM arbitrator U31.

Watchdog Timer

System reset and watchdog functions are implemented by a voltage regulator U6. The regulator asserts an active low reset pulse for a minimum duration of 200mS after Vcc has reached 4.75V. Diodes CR1 and CR2 allow the HALT* and RESET* lines of the microprocessor to be pulled low with the reset line. After the reset period, pullup resistors R10 and R11 guarantee logic high levels at their respective pins. Should the processor assert HALT or RESET internally, diodes CR1 and CR2 prevent contention with the regulator. Resistor R8 guarantees that reset remains low while VCC is falling to 0V. The system software must service the watchdog (pin 6 of U6) at a minimum of every 1.6 seconds or the regulator will assert the reset line. Removal of resistor R9 high impedances the WDI input of the regulator allowing it to disable the watchdog function.

Address Decoder EPLD

The address decoder EPLD U3 functions as the interface to all the peripherals. This includes generating chip selects and wait states, interfacing to the front panel switches and Trim Knob control, and providing the logic necessary for auto-vector interrupts. The EPLD needs a 12.5MHz clock at its GCLK input. To facilitate testing, all the output pins can be TRI-STATED by driving the GOE2* pin high. The address decoder EPLD provides four main functions.

- Address decode/wait state generation
- Prioritized interrupt logic
- Front panel interface
- Asynchronous serial multiplexer

→

→ Theory of Operation for PN800814

Prioritized Interrupt Logic

Programmed into the address decoder EPLD, the interrupt logic consists of a 4 to 3 priority encoder and additional logic to signal the microprocessor to use auto-vector interrupts. All sources of interrupts come from the DUART U30.

Front Panel Interface

The microprocessor U5 reads the front panel switches, the Trim Knob control, and 4 dip switches (SW1) through the 16 bit I/O port on the address decoder EPLD. Access to the port is via the SWPORT address. The input from the four front-panel switches, the switch push of the Trim Knob control, and the quadrature position signals from the Trim Knob control are all processed through an identical digital debounce circuit. All the switch inputs must have pull-up resistors.

Once debounced, the quadrature position signals from the Trim Knob control are fed through a decoder and an 8-bit up/down counter in the address decoder EPLD. The 8-bit counter increments or decrements depending on the direction the Trim Knob control is turned. The 8-bit counter rolls-over to 0/255 when it reaches its maximum/minimum count.

Asynchronus Serial Multiplexer

The 7200_TM pin of the address decoder EPLD supplies the signal used to multiplex the channel A receive/transmit lines of the DUART U30. On power-up this pin will be set low.

Audio

For display processor 800814-001A, only the sound generator U27 was used. In version A, the ready line of the sound generator then goes inactive which keeps the chip select active for the device. The output of the sound generator for version A is bypassed with resistor R25 and capacitor C155 to suppress any high frequency oscillations in the audio amps output driver. For PCB 800814-001B and later, a sound generator daughter board was used instead of the sound generator at U27. This programmable sound generator, either U27 with an audio amplifier (U38) or a daughter board (801446-001) attached at U27, receives information from the data bus via latch U28. Clocking the data into the data latch starts the audio cycle by chip selecting the sound generator U27. Once the sound generator is finished with its cycle, it raises the ready line which in turn deselects the device and signifies to the DUART U30 that it is ready for another audio cycle. After AC coupling capacitor C9, the audio signal is applied to a variable resistor R32 for volume control. The variable resistor is set so that maximum power to the speaker is achieved. The variable resistor R32 in conjunction with C159 form a single pole roll-off filter at 3.18KHz. (Assuming that the pot is set at it's midpoint) Transistor Q7 allows for disabling of the audio signal during non-use so that speaker buzz or hiss may be kept to a minimum. The power amplifier driver U38 provides a fixed gain of 20 to the audio signal level. RC networks consisting of R45, C15 and R33, C11 provide for amplifier stability and bass boost gain. Finally AC coupling capacitor C18 allows only the audio to be presented to the 8 ohm 200mW bezel mounted speaker. Capacitor C14 provides 50 dB of power supply rejection on the audio amplifier output. →

→ Theory of Operation for PN800814

DUART and Serial Communication

All serial communication is handled by the DUART U30. A 3.6864 MHz crystal provides the local operating frequency for the DUART. This frequency was chosen for easy derivatives of the serial channel baud rates. This same clock frequency is buffered and utilized by the sound generator, either U27 or the daughter board 801446-001. A bank of DIP switches SW1 is connected to the DUART input port for system configuration. Each switch, when closed, will pull down an input line of the DUART. Serial communication can be to any one of three different ports. These ports include: Tram module through the housing, Smart-pac Upgrade Kit and the 2-inch writer. Serial channel A talks to the Tram module exclusively. Serial channel B alternates between the writer and the Smart-pac Upgrade Kit. This alternation is accomplished via the DUART control lines and a small logic section of the video RAM arbitrator EPLD U31. See that section for further clarification. The receive lines from the external 2-inch writer are optically isolated for equipment isolation reasons.

Video

The presentation of video on the LCD display is accomplished by using a pair of display controllers U23 and U33. These devices each represent either the top half or the bottom half of the LCD screen. At power up, they are configured to read data from the video RAMs and display this data on the LCD screen. The microprocessor U5 taps into the video RAMs and places the LCD data into these RAMs for use by the controllers. Each device is synchronized so that uniform presentation of data to the LCD screen is accomplished. The choice of 11.5MHz for the system clock was made to reduce flicker to a minimum.

→ Theory of Operation for PN800814

Video RAM Arbitrator

The video RAM arbitrator EPLD U31 functions as the microprocessor U5 interface to the video RAM and as a serial multiplexer. The chip selects for the master and slave graphics LCD controllers (GLC) are also generated by this EPLD.

Video Interface

The video interface portion of the video RAM arbitrator EPLD has an identical master and slave section. From the view point of the microprocessor, the video RAM data is NOT contiguous and resides at odd addresses. The microprocessor may read and write to the video ram while the GLC can only read from the video RAM. The video interface switches between the microprocessor or GLC address depending on who is accessing the video RAM. When the microprocessor reads the video RAM, the video interface synchronizes the microprocessor read cycle with the GLC read cycle. Wait states are added to the microprocessor read cycle until the two read cycles synchronize. Once synchronized, the video interface divides the GLC read cycle into two read cycles, one for the GLC and one for the microprocessor. The GLC read cycle starts first and latches its data into the octal latch U8 or U25. The microprocessor read cycle starts by switching in the microprocessor address to the video RAM via multiplexers. The data from the video ram is routed to the microprocessor data bus via the transceiver U21. This completes the read cycle. The microprocessor write cycle operates identically to the read cycle except the data direction is opposite.

Serial Multiplexer

The serial multiplexer portion of the video RAM arbitrator EPLD provides the logic to select the appropriate receive path for receive channels A and B of the DUART U30 as well as inverting the AUX_XMT line. The following function tables present the data path for the DUART receive channels B and A respectively.

	Inputs		**Output**
AUX_RCV	AUX_TX	AUX_TXD	RXDB
L	X	0	1
L	X	1	0
H	0	X	1
H	1	X	0

	Inputs		**Output**
	7200_TM	D_TXD	RXDA
	L	L	H
	L	H	L
	H	X	L

→

➔ Theory of Operation for PN800814

On/Off Control

The power switch circuitry assumes that a pullup resistor of approximately 50K to +5.0V is connected to the open collector I/O line ON/OFF*. When the power switch is in the open position, the pullup resistor dominates the open collector I/O line indicating a logic high to the device monitoring this I/O line. The monitoring device sources no power to the processor PCB under this logic high condition.

When the power switch is closed, the pullup resistor is pulled low with all of it's current flowing through the power switch to ground. The device now sources power to the processor PCB to energize the board. After the board powers up, the reset pulse duration is initiated by the voltage regulator U6. During this time that reset is active, transistor Q6 is energized which in turn energizes transistor Q5. The LTCH_PWR line is therefore pulled low during reset. After the reset pulse goes high, and LTCH_PWR is asserted high, transistor Q4 is energized. (Note that no current flows through transistor Q4 as long as the power switch remains in the closed position). This allows transistor Q3 to remain off and the signal PWR_ON to go high. When the power switch opens, transistor Q4 conducts the pullup current to ground through resistor R27. This biases on transistor Q3 pulling the signal PWR_ON low. This allows the processor time to clean up things and shut off the contrast circuit before logic power goes away. After these functions are performed, the processor disables LTCH_PWR which in turn shuts off transistor Q4 allowing the ON/OFF* line to be pulled up by the power sourcing device. This is the signal to this device to remove the power. If for some reason LTCH_PWR cannot be removed, the next watchdog reset pulse energizes transistors Q5 and Q6 pulling LTCH_PWR signal low long enough to turn off transistor Q4.

Contrast Circuit and Control

The necessary voltage for contrast control is derived from the DC to DC converter U34. This converter makes ±12.0V from +5.0V input. By tying the V+ output to ground, a span of -24V is achieved from negative voltage to ground. Resistor R70 provides the necessary minimum load to the converter secondary for good startup and regulation. The VLCD_ON signal allows control over whether or not the negative voltage regulator U35 sees any input voltage. When active, the regulator provides a variable contrast voltage to the LCD panel (assuming a 1K pot is connected to the appropriate PCB pins).

List of Inputs and Outputs

The following list of inputs and outputs contains all connections on the display processor PCB. The list includes such information as whether a signal is an input or output, the nominal volatage range for each signal, the type of signal, and the maximum frequency the signal may have. The list is organized by connector.

Connector J1 (60-pin connector to software cartridge)

Pin Number	Signal Name	Signal Type
J1-1	Gnd	Board Ground Reference
J1-2	+5.0V	VCC
J1-3	NC	
J1-4	NC	
J1-5	A3	Proccessor Address
J1-6	A7	Proccessor Address
J1-7	A1	Proccessor Address
J1-8	A5	Proccessor Address
J1-9	A2	Proccessor Address
J1-10	A6	Proccessor. Address
J1-11	CD10	Tri-State - Data
J1-12	A13	Proccessor Address
J1-13	CD9	Tri-State - Data
J1-14	NC	
J1-15	CD8	Tri-State - Data
J1-16	CD14	Tri-State - Data
J1-17	CD0	Tri-State - Data
J1-18	CD15	Tri-State - Data
J1-19	CD2	Tri-State - Data
J1-20	CD12	Tri-State - Data
J1-21	CD13	Tri-State - Data
J1-22	CD6	Tri-State - Data
J1-23	CD11	Tri-State - Data
J1-24	CD4	Tri-State - Data
J1-25	NC	
J1-26	Gnd	Board Ground Reference
J1-27	A4	Proccessor Address
J1-28	A12	Proccessor Address
J1-29	CD5	Tri-State - Data
J1-30	A10	Proccessor Address
J1-31	CD1	Tri-State - Data
J1-32	A9	Proccessor Address
J1-33	A8	Proccessor Address
J1-34	A14	Proccessor Address
J1-35	CD7	Tri-State - Data
J1-36	A15	Proccessor Address
J1-37	CD3	Tri-State - Data
J1-38	A11	Proccessor Address
J1-39	A18	Proccessor Address
J1-40	AS*	CMOS Output

→

→ List of Inputs and Outputs

→ Connector J1 (60-pin connector to software cartridge)

Pin Number	Signal Name	Signal Type
J1-41	A20	Proccessor Address
J1-42	+5.0V	VCC
J1-43	R/W*	CMOS Output
J1-44	NC	
J1-45	A22	Proccessor Address
J1-46	A21	Proccessor Address
J1-47	A17	Proccessor Address
J1-48	LDS*	CMOS Output
J1-49	A16	Proccessor Address
J1-50	A19	Proccessor Address
J1-51	UDS*	CMOS Output
J1-52	A23	Proccessor Address
J1-53	NC	
J1-54	+5.0V	VCC
J1-55	NC	
J1-56	NC	
J1-57	NC	
J1-58	NC	
J1-59	+5.0V	VCC
J1-60	GND	Board Ground Reference

Connector J2 (18-pin connector to front panel)

Pin Number	Signal Name	Signal Type
J2-1	GND	Board Ground Reference
J2-2	NC	
J2-3	GND	Board Ground Reference
J2-4	TRIM_B	Input - TTL
J2-5	TRIM_A	Input - TTL
J2-6	TRIM_PUSH	Input - Switch
J2-7	NC	
J2-8	NC	
J2-9	SPEAKER–	Board Ground Reference
J2-10	SPEAKER+	Audio Out
J2-11	TRIM_POWER	+5.0V
J2-12	BP_ZERO	Input - Switch
J2-13	FREEZE	Input - Switch
J2-14	ALARM_RST	Input - Switch
J2-15	NC	
J2-16	CONSTRAST ADJ	To potentiometer
J2-17	CONSTRAST ADJ	From potentiometer
J2-18	CONSTRAST ADJ	From potentiometer

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➔ List of Inputs and Outputs

Connector J3 (12-pin connector to writer port)

Pin Number	Signal Name	Signal Type
J3-1	AUX_TX+	RS-422 Receive
J3-2	AUX_TX–	RS-422 Receive
J3-3	AUX_RX+	RS-422 Transmit
J3-4	AUX_RX–	RS-422 Transmit
J3-5	GND	Board Ground Reference
J3-6	ON/OFF*	Open Collector Input
J3-7	NC	
J3-8	+9.0V to +16.5V	D.C. Power In
J3-9	GND	Board Ground Reference
J3-10	GND	Board Ground Reference
J3-11	GND	Board Ground Reference
J3-12	GND	Board Ground Reference

NOTE: J3-9 thru J3-12 are the cable shield connections.

Connector J4 (60-pin gold fingers connector to upgrade kit)

Pin Number	Signal Name	Signal Type
J4-1	GND	Board Ground Reference
J4-2	+9.0V to +16.5V	D.C. Power in
J4-3	AUX_TXD	Input - TTL
J4-4	AUX_RXD	Output - CMOS
J4-5	ON/OFF*	Open Collector Input
J4-6	D_TXD*	Input - TTL
J4-7	D_RXD	Output - CMOS
J4-8	+9.0V to +16.5V	D.C. Power In
J4-9	+9.0V to +16.5V	D.C. Power In
J4-10	+9.0V to +16.5V	D.C. Power in
J4-11	NC	
J4-12	GND	Board Ground Reference
J4-13	GND	Board Ground Reference
J4-14	GNC	Board Ground Reference
J4-15	NC	
J4-16	NC	
J4-17	NC	
J4-18	NC	
J4-19	NC	
J4-20	NC	

➔ List of Inputs and Outputs

Connector J5 (3-pin connector to LCD backlight)

Pin Number	Signal Name	Signal Type
J5-1	CCFT Hot	High Voltage
J5-2	NC	
J5-3	CCFT RTN	High Voltage Return

Connector J6 (20-pin connector to LCD power and data)

Pin Number	Signal Name	Signal Type
J6-1	+5V	Logic Power to LCD
J6-2	GNC	Board Ground Reference
J6-3	VLCDD	Negative Power Output
J6-4	LP	CMOS Output
J6-5	FR	CMOS Output
J6-6	YDIS	CMOS Output
J6-7	YSCL	CMOS Output
J6-8	DIN	CMOS Output
J6-9	XSCL	CMOS Output
J6-10	XECL	CMOS Output
J6-11	MD0	CMOS Output Data
J6-12	MD1	CMOS Output Data
J6-13	MD2	CMOS Output Data
J6-14	MD3	CMOS Output Data
J6-15	SD0	CMOS Output Data
J6-16	SD1	CMOS Output Data
J6-17	SD2	CMOS Output Data
J6-18	SD3	CMOS Output Data
J6-19	+5V	Enable
J6-20	NC	

Connector J7 (2-pin connector to power on/off)

Pin Number	Signal Name	Signal Type
J7-1	ON/OFF*	Open Collector I/O
J7-2	GND	Board Ground Reference

Revisions to the Assemblies

The baseline revision for this PCB is pn 800814-001D. To convert the parts list back to a previous version, change all part numbers, descriptions, and quantities as indicated in the Revision History table below.

An older version of the display processor assembly (PN 85638-006) is provided after this page.

PN 800814-001 Revision History						
Revision	**Reference Designation**	**Description**	**Revision's Part Number**	**Qty**	**Baseline Part Number**	**Qty**
A		Initial Production Release				
B	—	Circuit Board	800815-001A	1	800815-001B	1
C		Documentation Change Only				
D	U27	Sound Generator PCB (Sound generator changed from IC to PCB)	3210-496	1	801446-001A	1
	C155	Cap, Cer, 0.1µF, 20%, 25V	404370-001	1	Not Used	
	R25	Res, Cer, 10 Ω, 1%, 1/8W, SM	1082-786	1	Not Used	
	—	Circuit Board	800815-001B	1	800815-001C	1
	—	Schematic Diagram	SD800814-001A		SD800814-001B	

Parts List 85638-006C

Reference Designation	Description	Part Number	Qty
C1, 7, 11, 32	Cap, Tant, 4.7µF, 10%, 35V	1224-475	4
C2 – 6, 8, 9, 10, 12 – 21, 23 – 28, 31, 33 – 39, 44, 45, 47, 51 – 55, 60, 61, 64, 80, 81, 82	Cap, Cer, 0.1µF, +80/-20%, 50V	1287-104	46
C22, 29, 30	Cap, Cer, 10pF, 10%, 50V	1281-100	3
C40	Cap, MPE, 0.033 µF, 10%, 100V	1204-333	1
C41	Cap, Al Axial, 300µF, 20%, 25V	1273-337	1
C42	Cap, Tant, 100µF, 10%, 20V	1223-107	1
C43	Cap, MPE, 0.47 µF, 10%, 50V	1102-474	1
C46	Cap, Tant, 4.7µF, 10%, 10V	1221-475	1
C48, 50, 59, 85	Cap, MPE, 0.1µF, 10%, 50V	1102-104	4
C49	Cap, Tant, 33µF, 10%, 20V	1223-336	1
C56	Cap, Cer, 0.33µF, +80/-20%, 50V	1110-334	1
C57, 58, 63, 86	Cap, Tant, 10µF, 10%, 35V	1120-106	4
C62	Cap, Tant, 10µF, 10%, 35V	1224-106	1
C65 – 79, 87, 88, 89	Cap, Cer, 0.1µF, 20%, 50V	404370-001	18
C84	Cap, MPE, 0.1 µF, 10%, 63V	1101-103	1
C90, 91	Cap, Tant, 1.0µF, 10%, 35V	1224-105	2
CR2	Transorb, 5V TVS505	2002-505	1
CR3 – 6, 8 – 23, 28 – 31, 33, 34, 38, 39	Diode FDH300	2003-001	28
CR7	Diode, Schottky 1N5711	2050-263	1
CR32, 36	Transorb, 18V TVS518	2002-518	2
CR35	Diode 1N4004	2401-100	1
J818	Connector, 60-Pin, Horizontal	17021-030	1
J828	Connector, Header, 3-Pin – w/Locks	1850-103	1
J829	Connector, Header, 18-Pin	1848-318	1
J830	Connector, Header, 12-Pin	1848-312	1
J831, 832	Socket, Receptable, 8-Pin	17023-002	2
J838	Connector, PC Header, 2-Pin	17043-002	1
J839	Connector, ZIF, 20-Pin, Horizontal	17054-001	1
Q1, 3, 4	Transistor, NPN 2N3904	2503-904	3
Q2	Transistor, Darlington, PNP TIP32	2699-013	1
Q5, 8	Transistor, NPN 2N2484	2510-428	2
Q6	Transistor, PNP MPS-A56	2652-002	1
Q7	Transistor, NPN MPS-A06	2652-001	1
R1, 2, 3, 10, 35, 82, 83	Res, MF, 1.00K, 1%, 1/4W	1023-191	7
R4, 9, 11 – 16, 19 – 25, 28, 34, 37 – 41, 47, 48, 49, 60, 64, 65, 66, 68, 70, 74, 79, 80, 81, 87, 88, 90, 91, 94, 98	Res, MF, 10.0K, 1%, 1/4W	1023-287	41
R7	Res, MF, 4.75K, 1%, 1/4W	1023-256	1
R8	Res, MF, 47.5 Ω, 1%, 1/4W	1023-065	1
R17, 18, 42–46, 51–55, 58, 61, 72, 73, 77, 97	Res, MF, 100 Ω, 1%, 1/4W	1023-096	18
R26, 27, 69, 71	Res, MF, 75.0 Ω, 1%, 1/4W	1023-084	4
R29, 33	Res, Comp, 10 Ω, 5%, 1/4W	1001-100	2

→ Parts List 85638-006C

Reference Designation	Description	Part Number	Qty
R30	Res, MF, 49.9K, 1%, 1/4W	1023-354	1
R31	Res, Var, 1K, 25-Turn	1038-102	1
R36	Res, Comp, 2.7 Ω, 5%, 1/4W	1001-027	1
R75, 86	Res, MF, 2.00K, 1%, 1/4W	1023-220	2
R78	Res, 0 Ω	1023-000	1
R84	Res, Var, 10K, 25-Turn	1039-103	1
R85	Res, MF, 100K, 1%, 1/4W	1023-383	1
R89	Res, Comp, 1K, 5%, 1/4W	1001-102	1
R92	Res, MF, 20.0K, 1%, 1/4W	1023-316	1
R93	Res, MF, 24.9K, 1%, 1/4W	1023-325	1
R95	Res, MF, 4.99K, 1%, 1/4W	1023-258	1
R96	Res, MF, 750K, 1%, 1/4W	1023-467	1
R99	Res, MF, 18.2K, 1%, 1/4W	1023-312	1
R100	Res, WW, 0.4Ω, 5%, 1/2W	1017-004	1
R101	Res, MF, 210 Ω, 1%, 1/4W	1023-127	1
S1	Switch, Dual In-Line, 2-Pole	1616-002	1
S2	Switch, 4-Pole, Dual In-Line	1616-004	1
T1	Power Inverter, 9 – 16 V dc Input E629	3148-004	1
T2	Power Convertor, 9V-to-16V, 500mA	3121-009	1
TP1, 2, 3	PC Post	1778-604	3
U1, 3, 10, 27	RAM, Static, 32K x 8-Bit 62256	3203-256	4
U5	Microprocessor, 12-MHz 68HC000	3054-003	1
U6, 7	Counter/Divider, Binary, 12-Stage HC4040	3029-040	2
U8, 67	Flip-Flop, Type D, Dual AC74	3061-074	2
U9, 15, 16	Res Ntwk, 10K, SIP	1057-103	3
U11 – 14, 24, 25, 26, 37	Data Selector, 1-Line-of-2-Line, Quad/Multiplexer, 2-Line-to-1-Line, Quad ACT157	3060-157	8
U17	EPLD, Programmed, Trim Knob Control Interface	84072-003	1
U18	EPLD, Programmed, Address Decoder and Strobe Generator	84071-003	1
U19	Asynchronous Receiver/Transmitter, Dual 68C681	3015-601	1
U20, 35	Transceiver, Bus, Octal ACT245	3060-245	2
U21, 36	Latch, Type D, Octal ACT373	3060-373	2
U22, 23	PAL, Programmed, Video RAM Arbitrator	84086-002	2
U28, 43	Buffer/Line Driver, Octal ACT244	3060-244	2
U29	NAND Gate, Open-Collector Output, 2-Input, Quad HCT03	3028-003	1
U30	Line Driver, Differential, Dual 9638	3009-638	1
U31, 38	Isolator, Optically Coupled 2602	3151-002	2
U32	Power Ampl, Audio LM386N	3102-386	1
U33	Sound Generator 76496A	3210-496	1
U34	Flip-Flop, Positive-Edge-Triggered, Type D, Octal HCT374	3028-374	1
U39	OR Gate, 2-Input, Quad HCT32	3028-032	1
U40	Inverter, Hex AC04	3061-004	1
U41, 42	Contact Bounce Eliminator, Hex 4490	3001-490	2
U44	Hybrid, Reset Circuit	3506-009	1
U45	Power Convertor, 5V-to-12V, 750mW	3121-010	1
U46, 47	Res Ntwk, 10K, SM	1061-103	2

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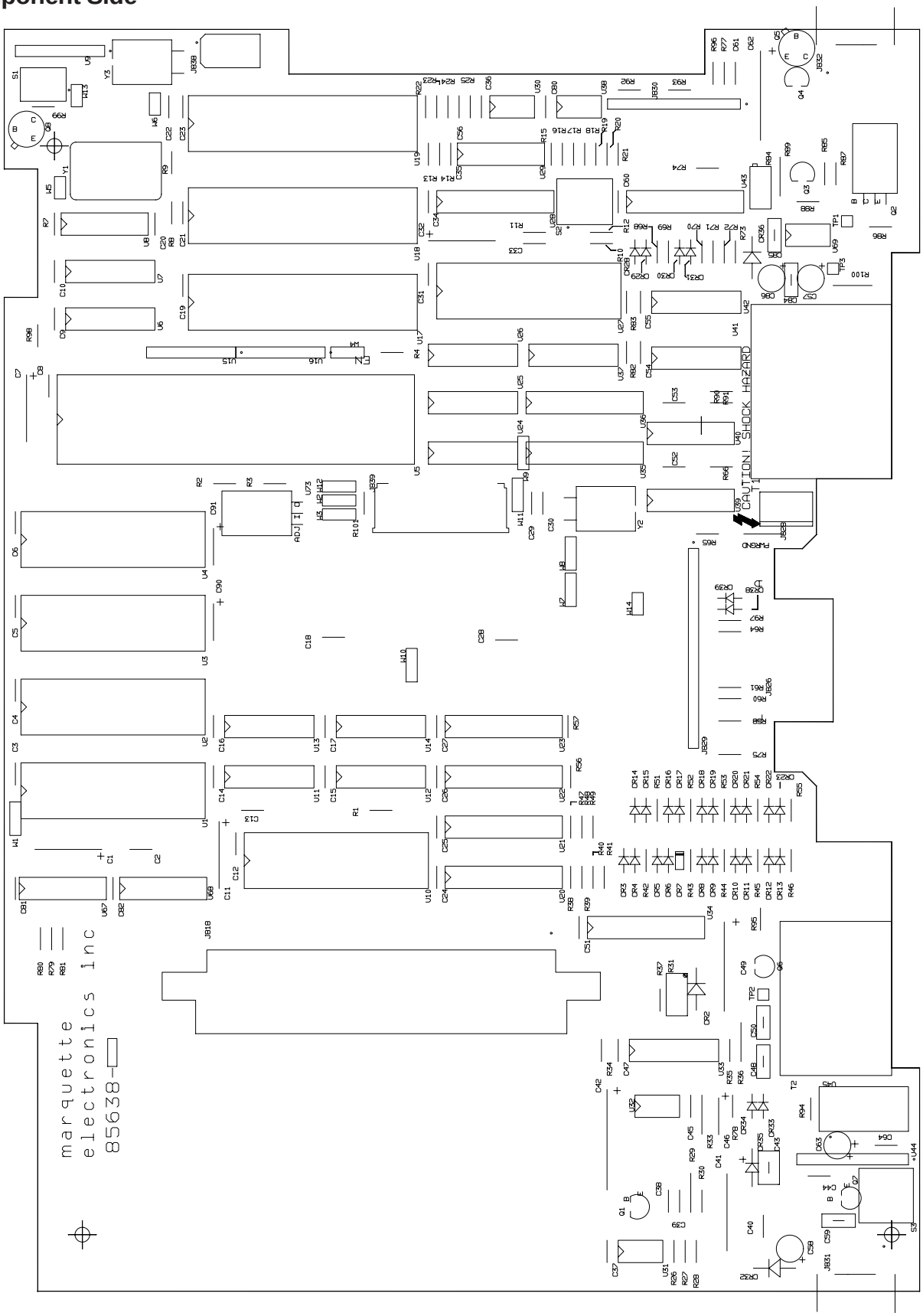
→ Parts List 85638-006C

Reference Designation	Description	Part Number	Qty
U48, 51, 52, 53	Buffer/Line Driver, Octal, SM ACT244	3059-244	4
U49, 50	Transceiver, Bus, Octal, SM ACT245	3059-245	2
U54 – 59, 62, 63	Res Ntwk, 100Ω, SM	1062-101	8
U60	NAND Gate, 2-Input, Quad , SM ACT00	3059-000	1
U46, 47	Res Ntwk, 10K, SM	1061-103	2
U48, 51, 52, 53	Buffer/Line Driver, Octal, SM ACT244	3059-244	4
U49, 50	Transceiver, Bus, Octal, SM ACT245	3059-245	2
U54 – 59, 62, 63	Res Ntwk, 100Ω, SM	1062-101	8
U60	NAND Gate, 2-Input, Quad , SM ACT00	3059-000	1
U61, 64	Flip-Flop, Type D, Dual, SM AC74	3062-074	2
U65, 66	Display Controller, SM E-1330BA	3215-002	2
U68	NOR Gate, 2-Input, Quad AC02	3061-002	1
U69	Operational Ampl LM10	3102-010	1
U70, 71	OR Gate, 2-Input, Quad , SM HCT32	3045-032	2
U72	OR Gate, 2-Input, Quad, SM AC32	3062-032	1
U73	Volt Rgltr, TO-220 LM337T	3114-102	1
W1, 4, 5, 6, 9, 10, 13, 14	Jumper, Mini	1859-201	8
W1, 4, 5, 6, 9, 10, 13, 14	Socket, Mini	1818-201	20
Y1	Oscillator, 25.000-MHz	1302-017	1
Y2	Crystal, 11.50-MHz	1300-320	1
Y3	Crystal, 36864-MHz	1300-312	1
–	Guide, Software Cartridge	58129-001	2
–	Nut, Keps, Hex, 4-40	4521-704	2
–	Screw, PNH, Phillips, SST, 4-40 x 1/4 (for Q2, U73)	4502-408	2
–	Screw, PNH, Phillips, SST, 4-40 x 3/16	4502-406	4
–	Socket, PC, Dual In-Line, 20-Pin (for U22, 23)	1790-220	2
–	Socket, PC, Dual In-Line, 32-Pin (for U1 – U4, U10, U27)	1790-432	6
–	Socket, PC, Dual In-Line, 40-Pin (for U17, U18)	1790-440	2
–	Socket, PC, Dual In-Line, 64-Pin (for U5)	1790-464	1
–	Thermal Compound	4850-015	AR
–	Washer	4550-014	4
–	Circuit Board	75638-004D	1
–	Schematic Diagram	SD85638-004B	1

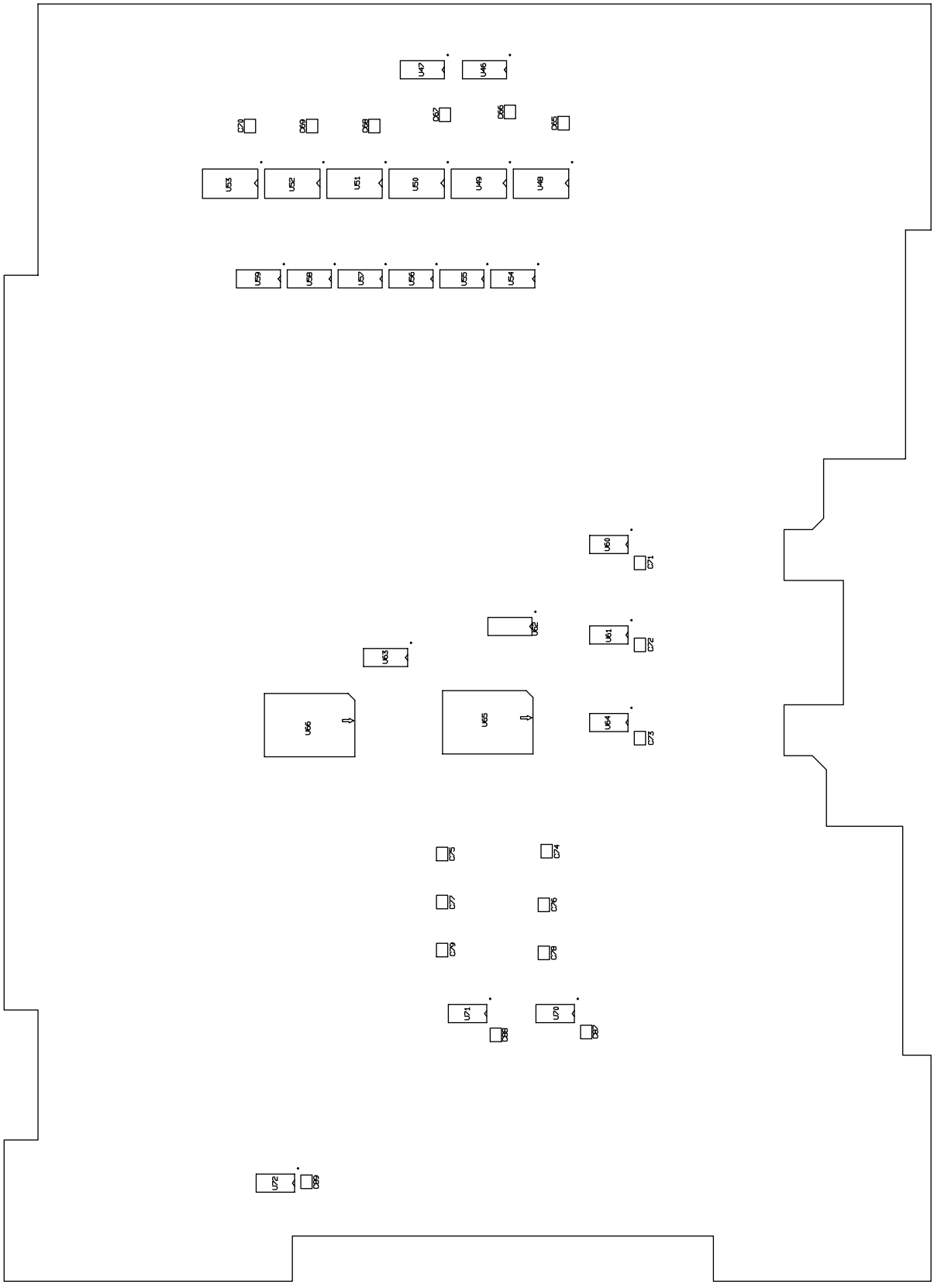
Parts Location Diagram 85638-006C

Component Side

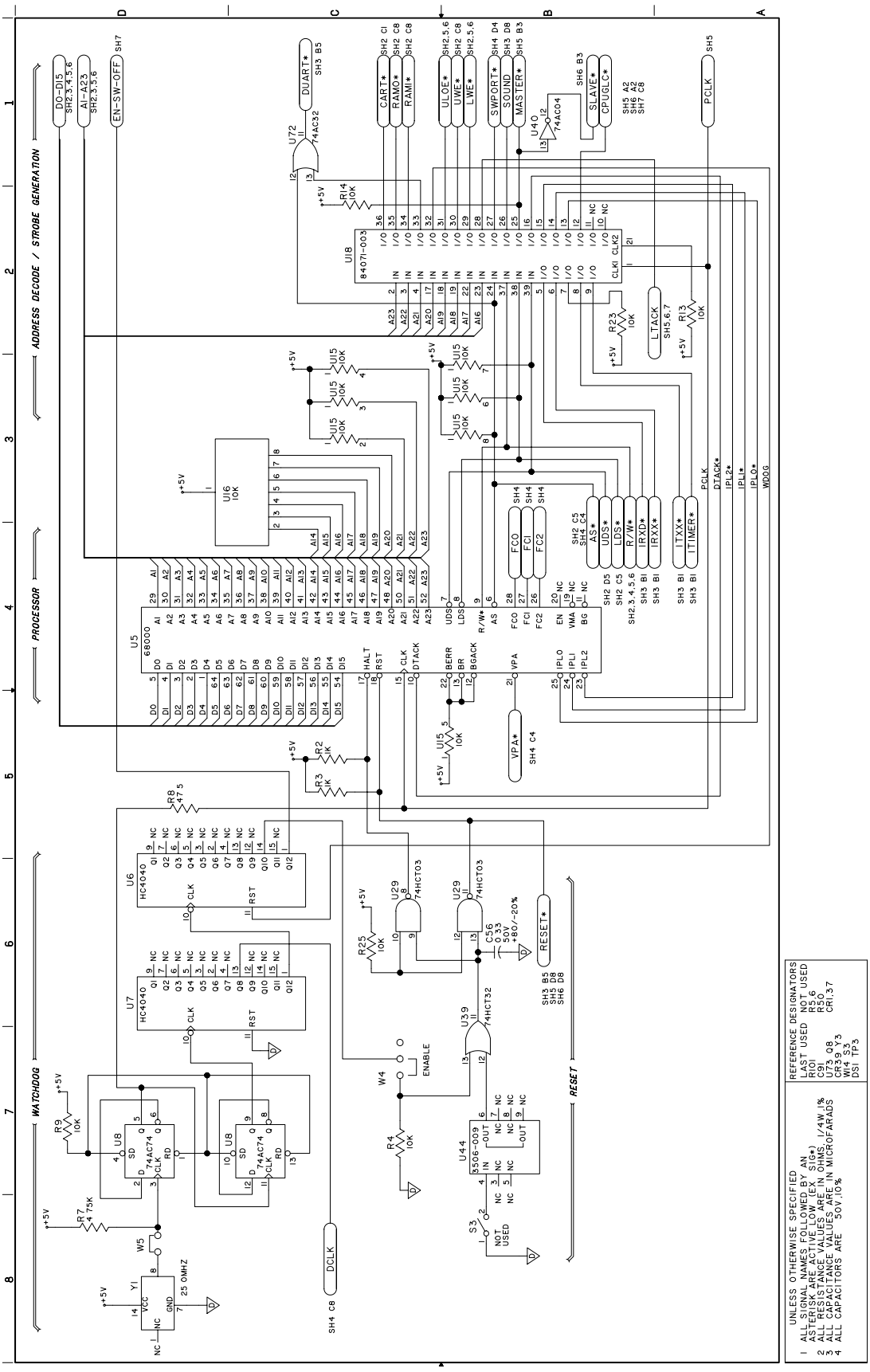


➔Parts Location Diagram 85638-006C

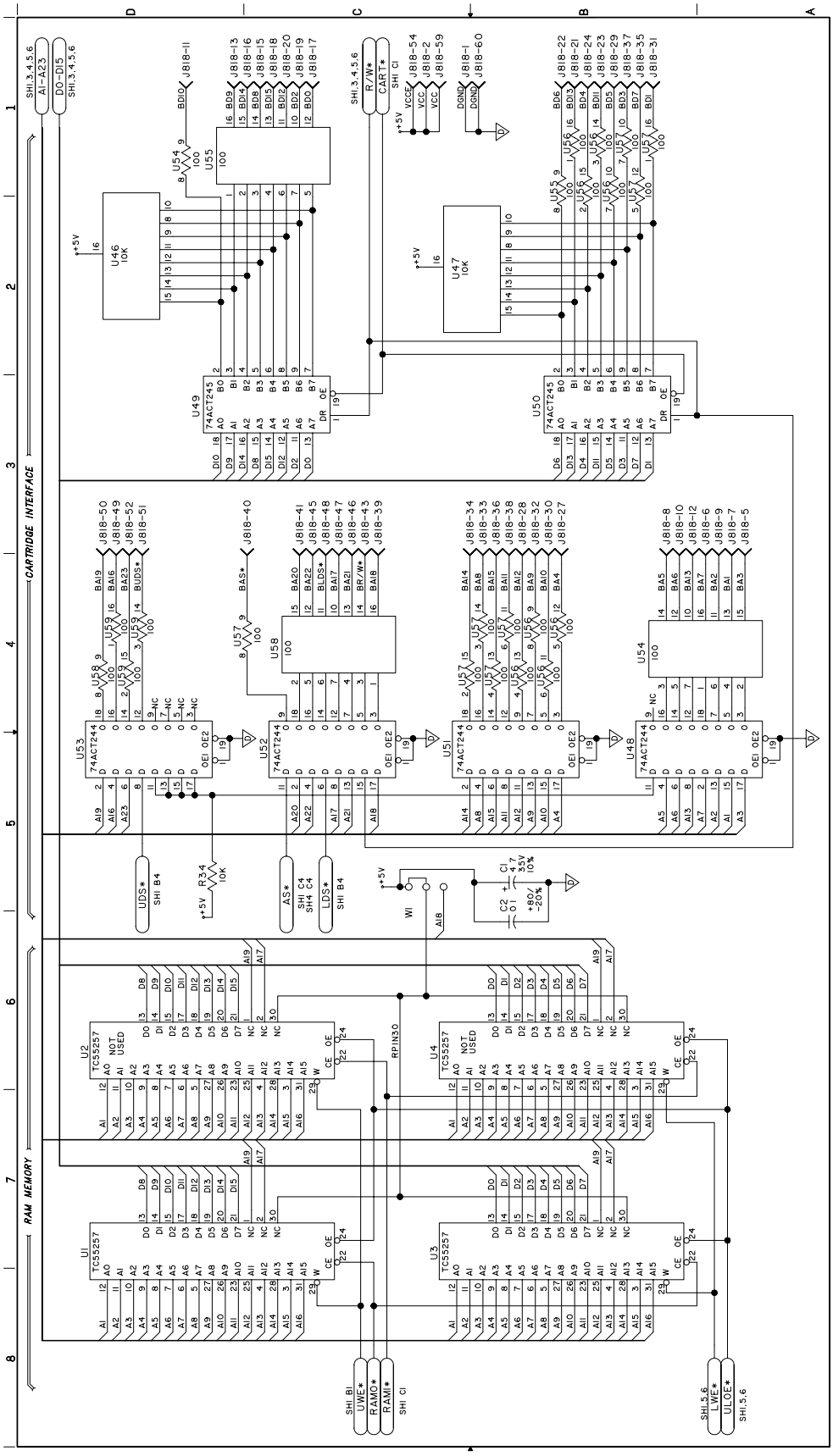
Solder Side



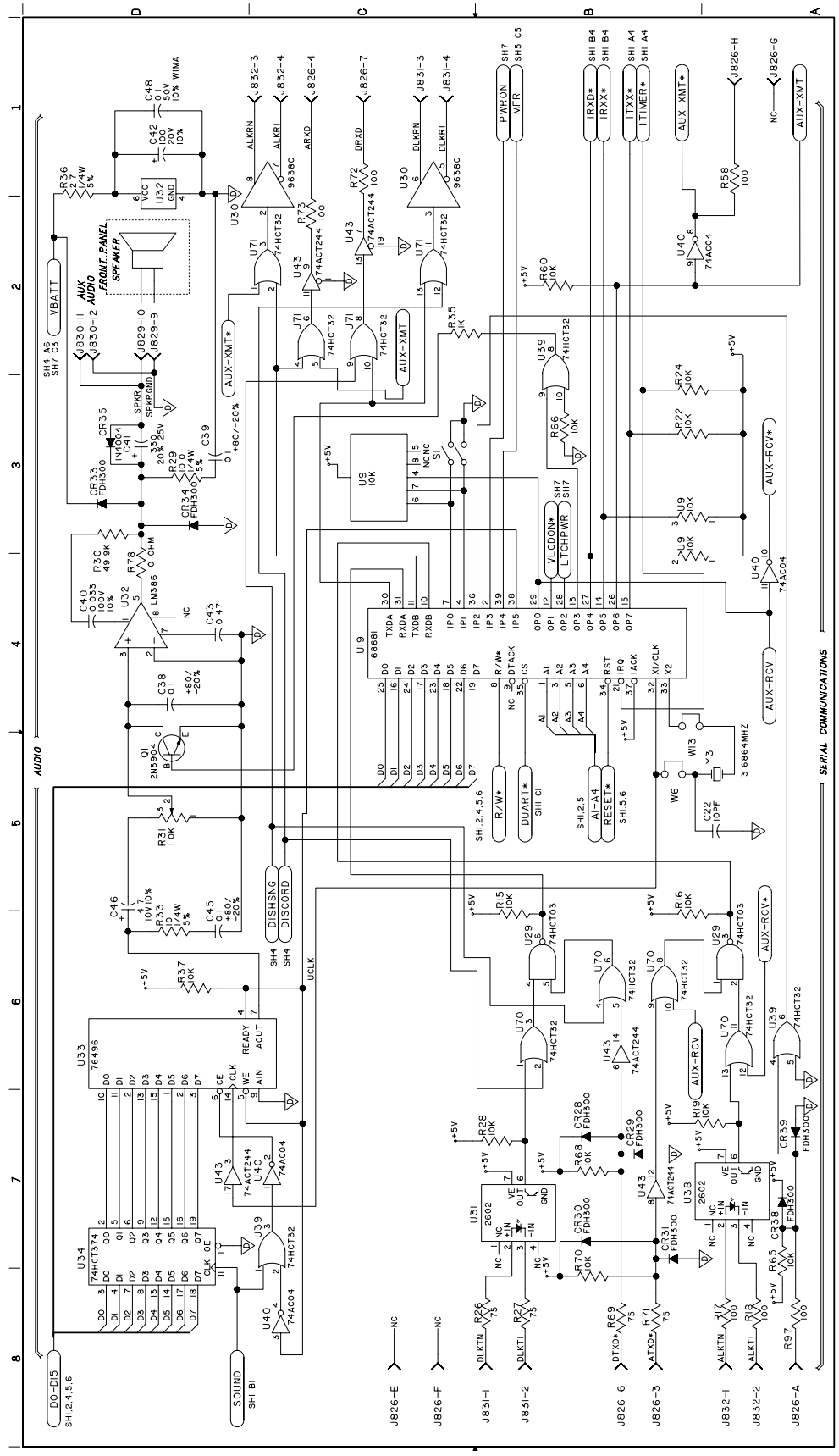
Schematic Diagram (Sheet 1 of 7) SD85638-006A



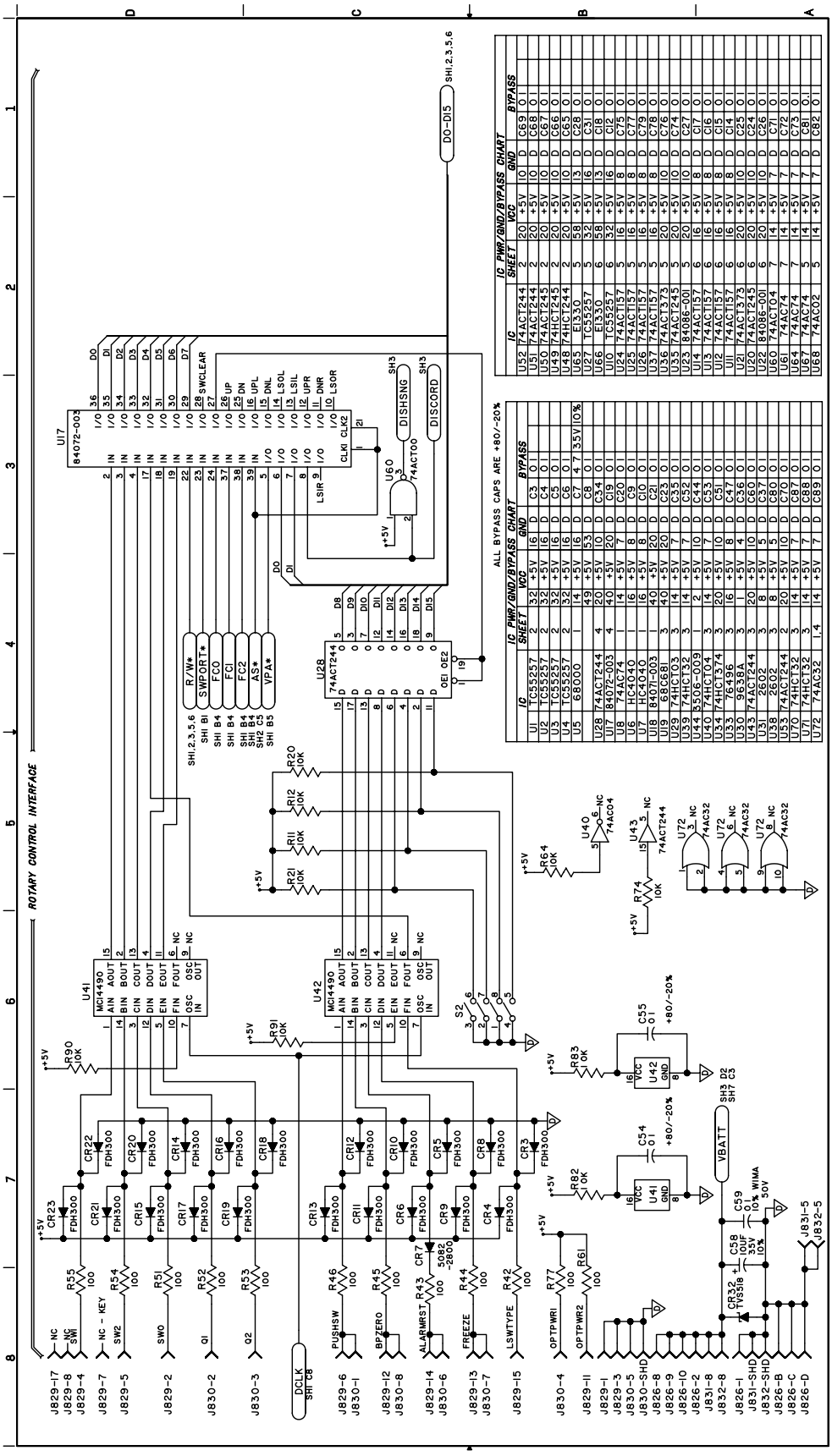
Schematic Diagram (Sheet 2 of 7) SD85638-006A



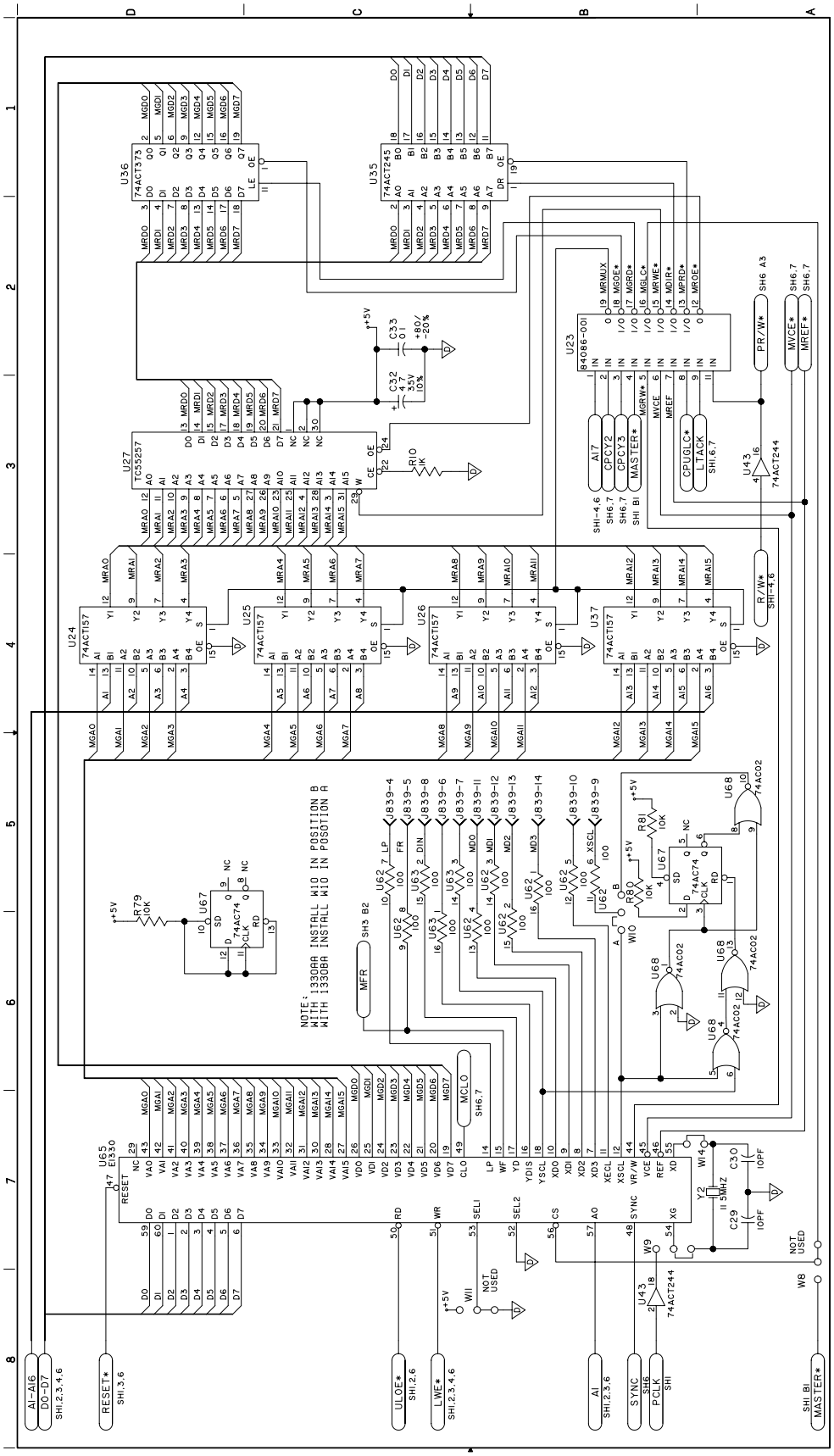
Schematic Diagram (Sheet 3 of 7) SD85638-006A



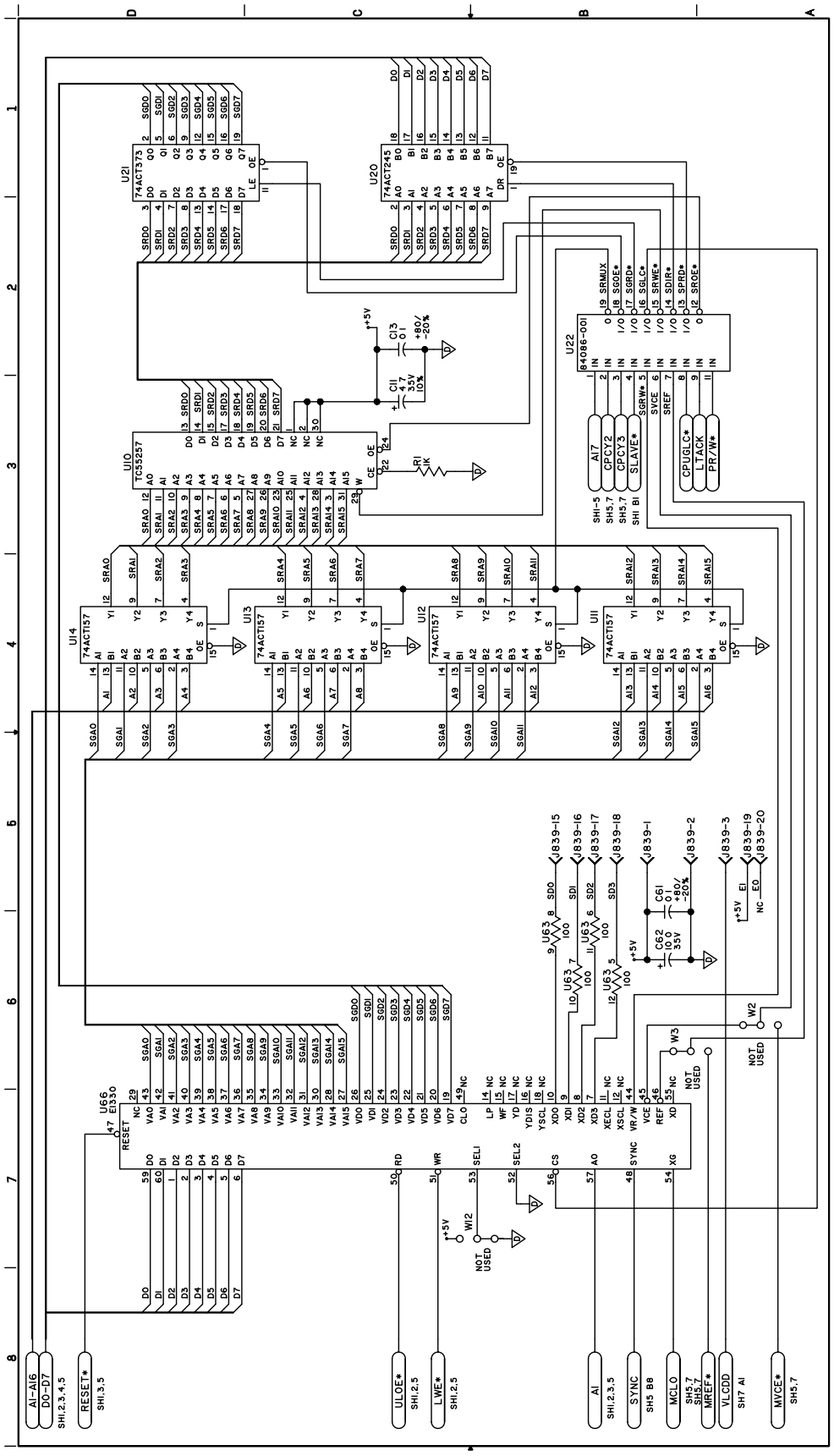
Schematic Diagram (Sheet 4 of 7) SD85638-006A



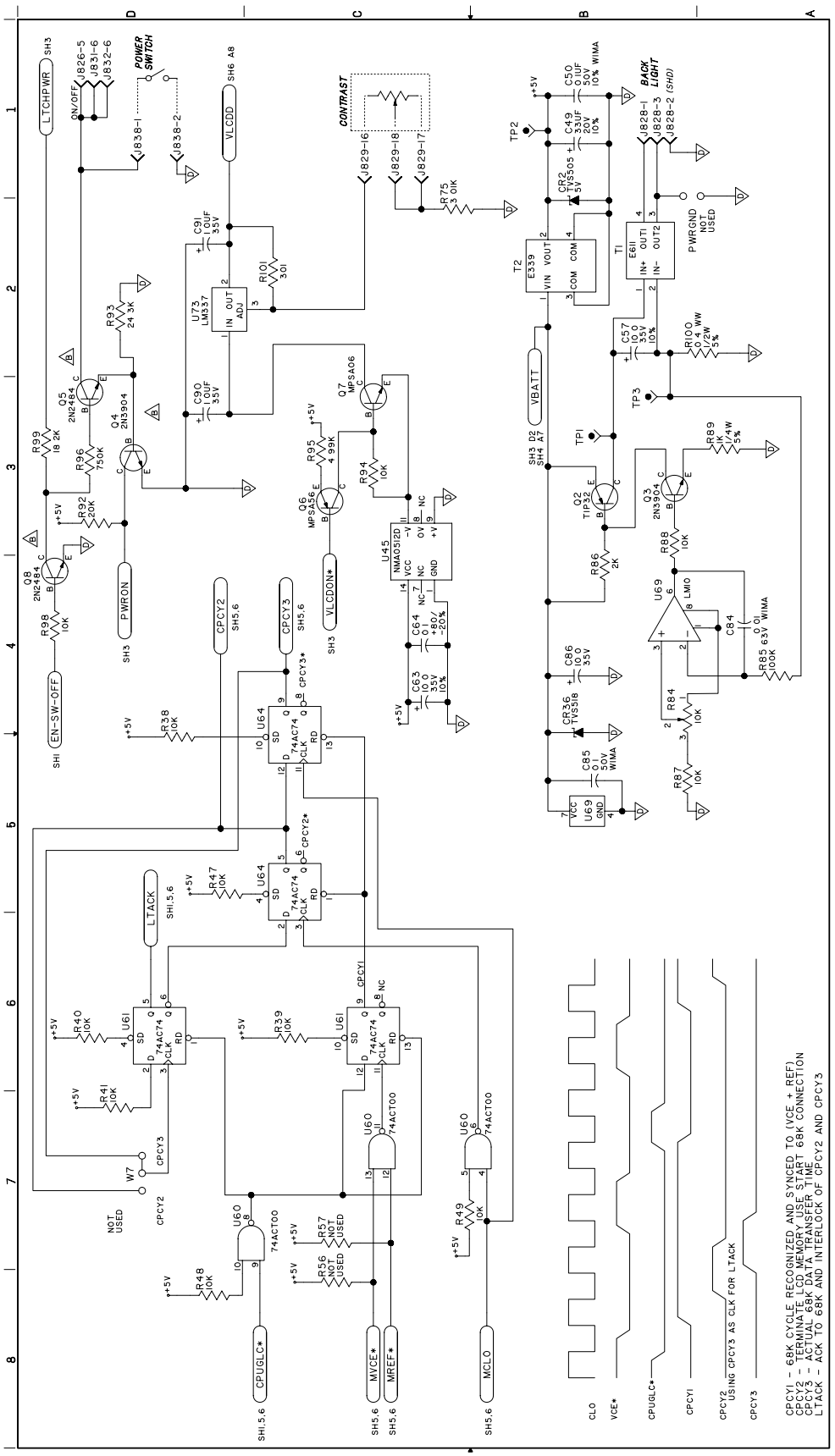
Schematic Diagram (Sheet 5 of 7) SD85638-006A



Schematic Diagram (Sheet 6 of 7) SD85638-006A



Schematic Diagram (Sheet 7 of 7) SD85638-006A



8 Switch PCB PN85639

WHAT IS IN THIS CHAPTER?

This chapter describes the switch PCB. This assembly collects user input from the three front panel keys for the display processor PCB. It also acts as a path for signals from the Trim Knob and contrast controls to the display processor PCB and routes audio signals from the display processor PCB to the speaker.

This chapter lists the parts that make up the switch PCB, and provides parts location and schematic diagrams for this circuit board.

The switch PCB is a part of the transport display assembly. For more information about that assembly, refer to Chapter 6, “Transport Display Assembly.”

Contents

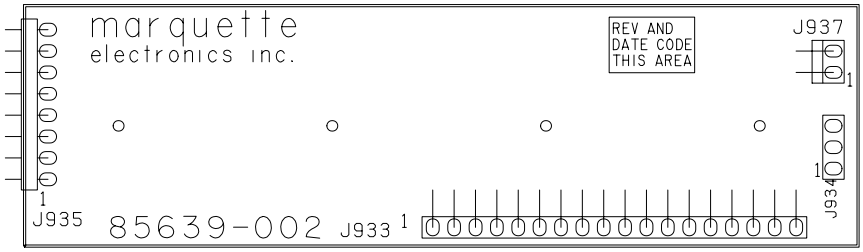
Parts List (PN 85639-002B) 8-2
Parts Location Diagram (PN 85639-002B) 8-2
Schematic Diagram (PN 85639-002B) 8-2

Parts List 85639-002B

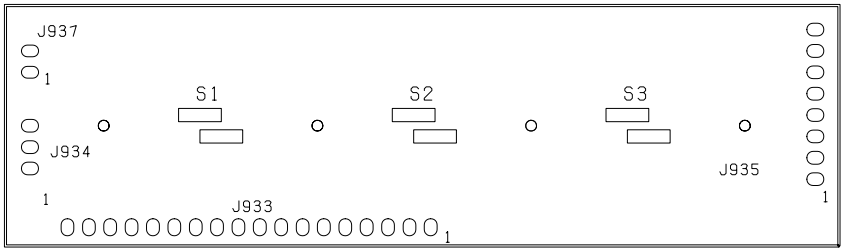
Reference Designation	Description	Part Number	Qty
J933	Connector, Header, 18-Pin, Horizontal	1848-318	1
J934	PC Post	1778-136	3
J935, 937	PC Post, Right Angle	1778-436	10
–	Circuit Board	75639-002B	1

Parts Location Diagram 85639-002B

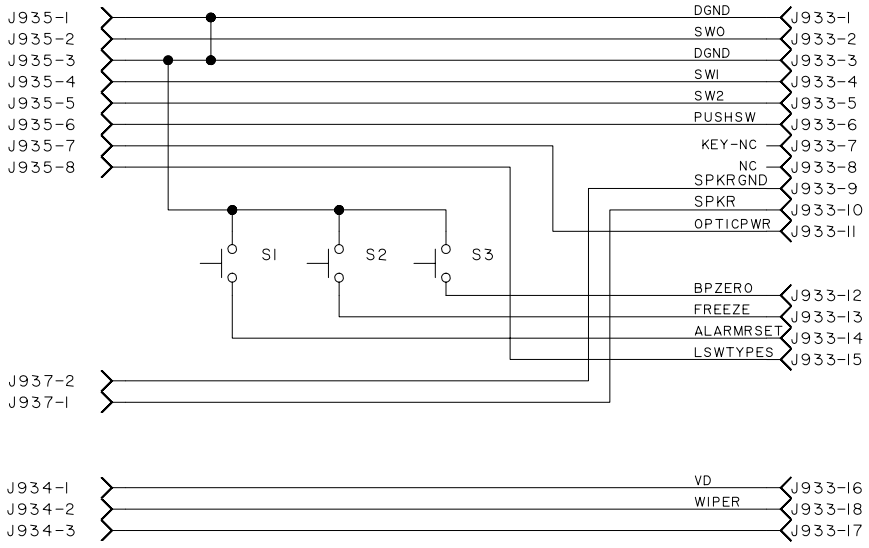
Component Side



Solder Side



Schematic Diagram 85639-002B



9 Cartridge PCB PN800138

WHAT IS IN THIS CHAPTER?

This chapter describes the cartridge PCB. This assembly slides into brackets on the display processor PCB and carries all of the software for the transport display assembly. It also includes some address decoding circuitry and can optionally include RAM.

There are two configurations of the cartridge PCB:

- PN 800138-001 has 128K of RAM (U11-14) installed on it
- PN 800138-002 does not have any RAM installed on it.

These two configurations share the same circuit board and schematic diagram. Unless otherwise noted, these two configurations are exactly the same.

This chapter lists the parts that make up the cartridge PCB, and provides parts location and schematic diagrams for this circuit board.

Contents

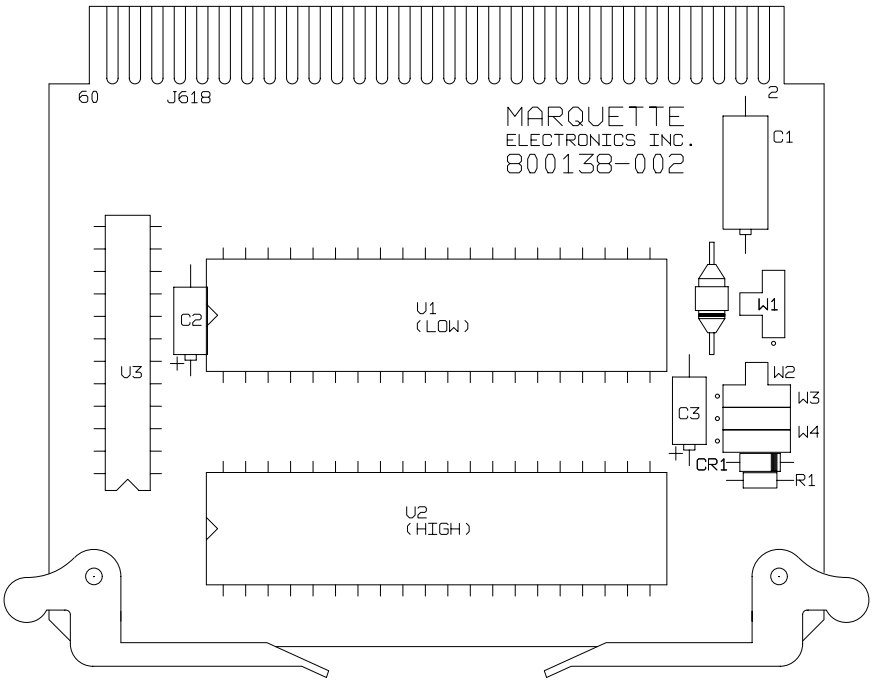
Parts List (PN 800138-001D/002C) 9-2
Parts Location Diagram (PN 800138-001D/002C)..... 9-3
Schematic Diagram (PN SD800138-001B) 9-4
Revisions to the Assemblies 9-5

Parts List 800138-001D/002C

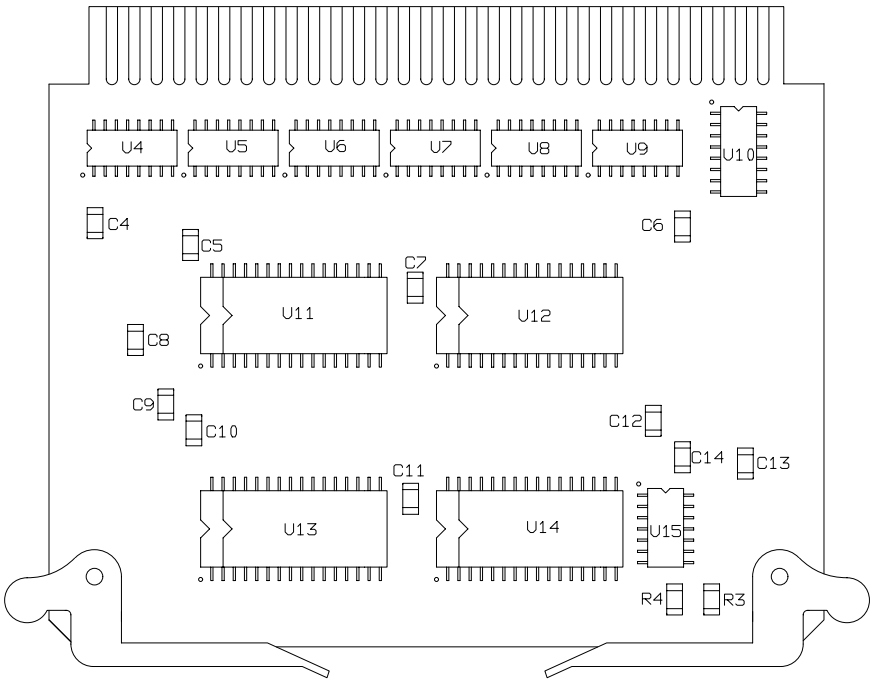
Reference Designation	Description	Part Number	Qty
C1	Cap, Tant, 39µF, 10%, 10V	1221-396	1
C2, 3	Cap, Tant, 4.7µF, 10%, 10V (For **800138-002** Only)	1221-475	2
CR1	Diode, Schottky 1N5711	2050-263	1
R1	Res, MF, 10.0K, 1%, 1/4W	1023-287	1
R3	Res, Cer, 100 Ω, 5%, 1/8W, SM	1081-101	1
R4	Res, Cer, 1M, 5%, 1/8W, SM	1081-105	1
U3	PAL, Programmed, Address Decoder and Strobe Generator	84051-001	1
U4 – 9	Res Ntwk, 100Ω, SM	1062-101	6
U10	Res Ntwk, 20K, SM	1061-203	1
U11 – 14	RAM, Static, 32K *x* 8-Bit , SM 62256FLP (Used on **PN 800138-001** Only)	3202-256	4
U15	OR Gate, 2-Input, Quad, SM AC32	3062-032	1
VR1	Transorb, 5V TVS505	2002-505	1
–	Circuit Board	800139-001C	1
–	Schematic Diagram	SD800138-001B	1

Parts Location Diagram 800138-001D/002C

Component Side

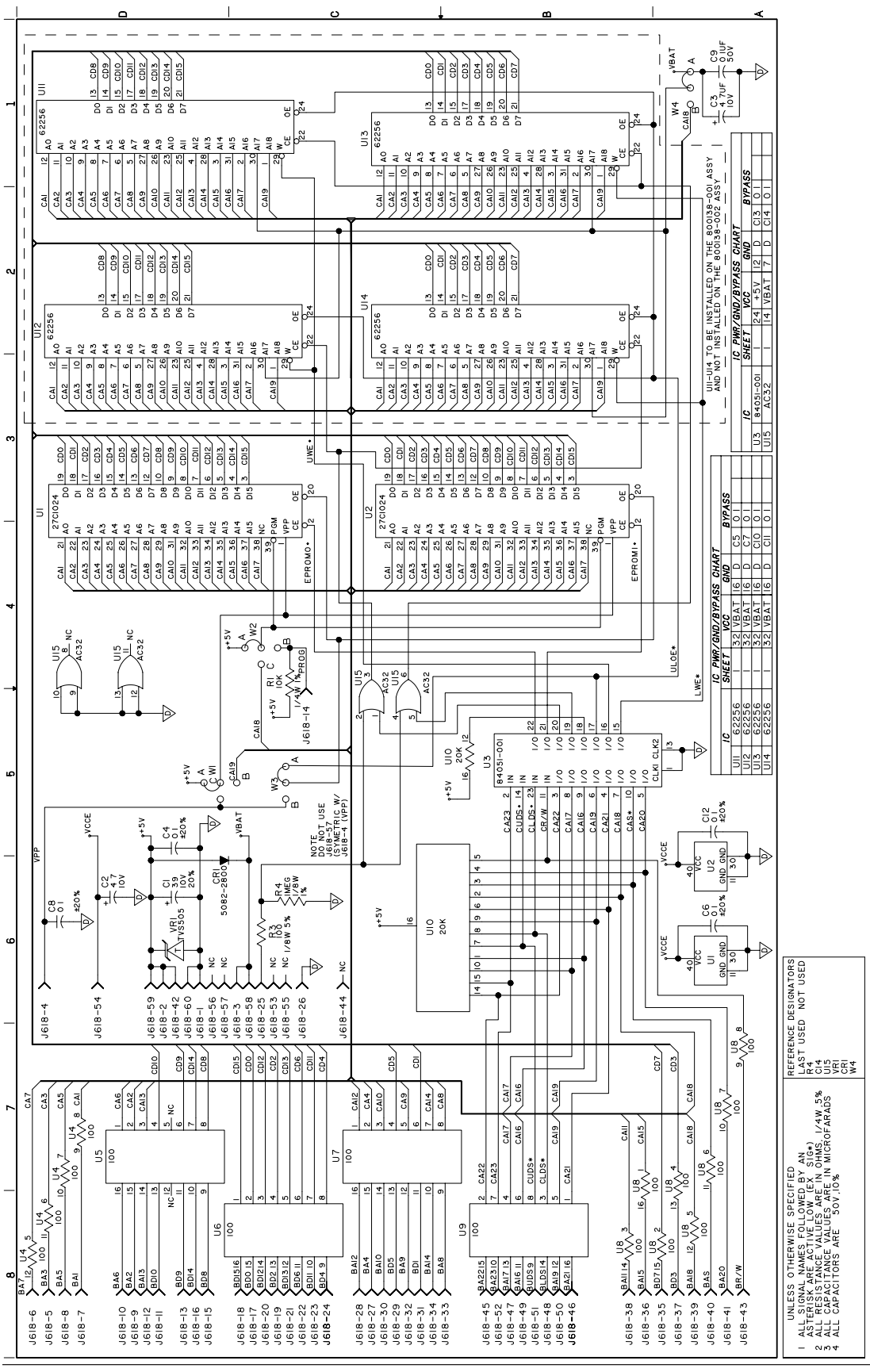


Solder Side



Schematic Diagram

SD800138-001B



Revisions to the Assemblies

The baseline revision for this PCB is pn 800138-001D/002C. To convert the parts list back to a previous version, change all part numbers, descriptions, and quantities as indicated in the Revision History tables below.

PN 800138-001 Revision History						
Revision	**Reference Designation**	**Description**	**Revision's Part Number**	**Qty**	**Baseline Part Number**	**Qty**
A		Not Used for Production				
B		Initial Release				
C	—	Circuit Board	800139-001B	1	800139-001C	1
D		Socket, Mini (for U1, U2, U3)	1818-201	104	Not Used	

PN 800138-002 Revision History						
Revision	**Reference Designation**	**Description**	**Revision's Part Number**	**Qty**	**Baseline Part Number**	**Qty**
A		Not Used for Production				
B	—	Initial Release				
C		Socket, Mini (for U1, U2, U3)	1818-201	104	Not Used	

For your notes

10 Battery Backpack Assembly PN402472

WHAT IS IN THIS CHAPTER?

This chapter contains information about the battery backpack assembly. The battery backpack assembly makes up the rear half of the Smart-pac transport display. It is the part of the transport display that Smart-pac battery packs slide on to.

This chapter includes a parts list, exploded view, and interconnection diagram for the battery backpack assembly.

The battery backpack assembly is a part of the Smart-pac transport display. For more information about that assembly, refer to Chapter 5, “Smart-pac Transport Display.”

Contents

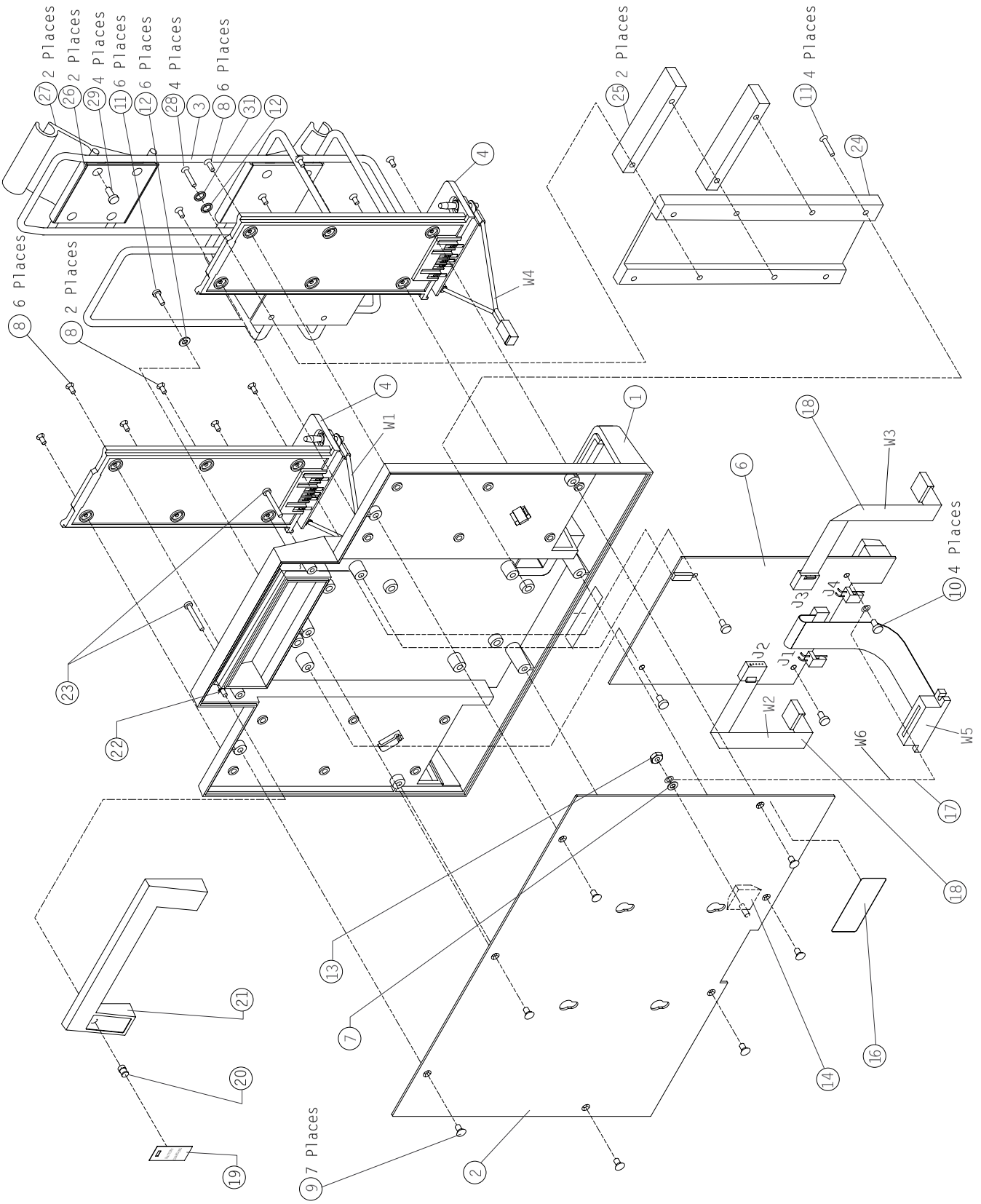
Assembly Configurations 10-2
Parts List (PN 402472-001K) 10-3
Exploded View (PN 402472-001K) 10-4
Interconnection Diagram (PN 402472-001K) 10-5

Parts List 402472-001K

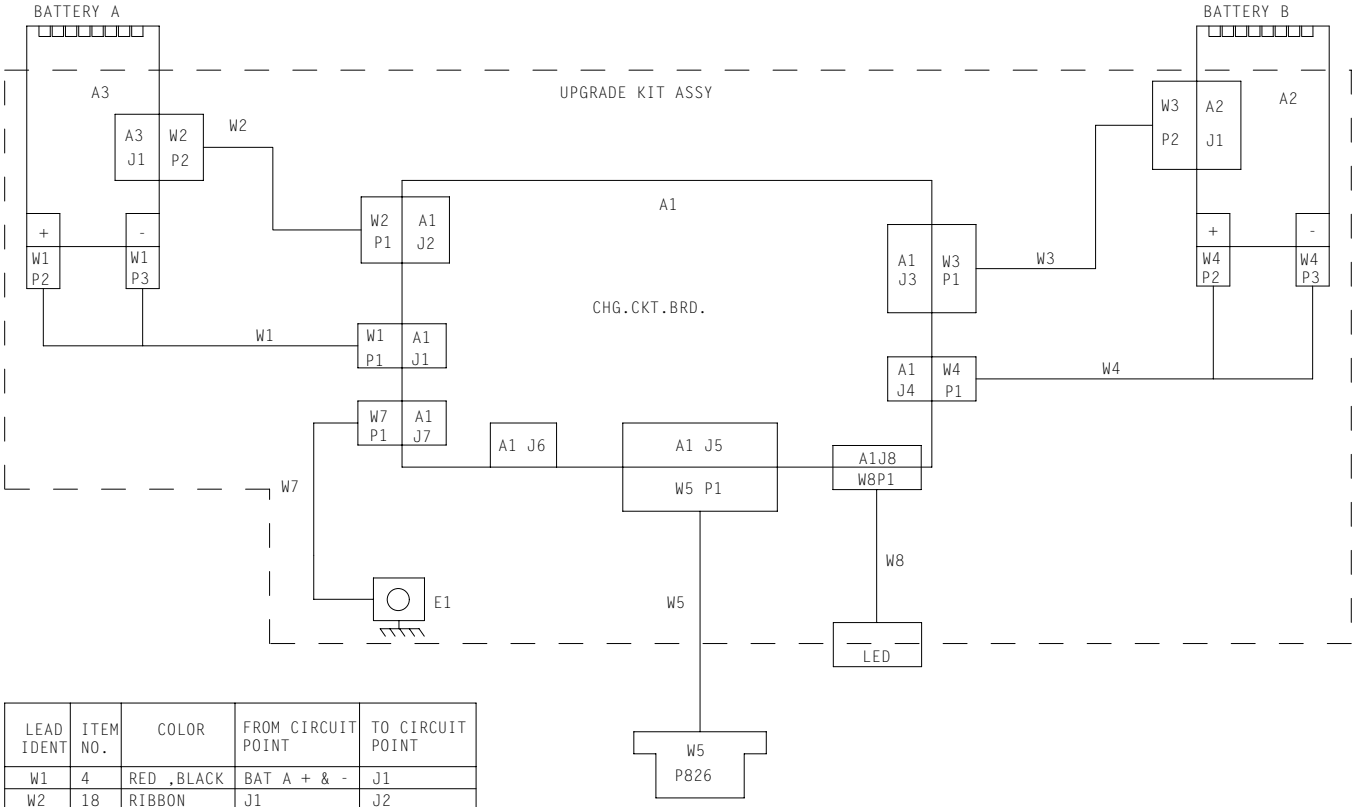
Item	Reference Designation	Description	Part Number	Qty
1		Housing	402025-001	1
2		Cover	402028-001	1
3		Module Holder Assembly	407017-001	1
4	A2, A3, W1, W4	Contact Plate Assembly[1]	403191-001	2
6	A1, W5	Battery Interface PCB[2]	403861-002	1
7		Washer, Lock, External/Internal Tooth, No 6	4520-806	1
8		Screw, FLH, Phillips, SST, 4-40 x 5/16	4505-410	12
9		Screw, FLH, Phillips, SST, 6-32 x 1/4	4505-608	7
10		Screw, BDGH, Phillips, 6-32 x 1/4	45074-608	4
11		Screw, BDGH, Phillips, 6-32 x 3/4	45074-624	4
12		Washer, Flat, SST, No 6	4520-006	6
13		Nut, Keps, Hex, 6-32	4521-706	1
14		Pad, Rubber Bumper	4616-002	1
15		Label, Model/Serial No.	70206-004	1
16		Label, Caution	70206-003	1
17	W7	Wire Assembly, Ground	80234-131	1
18	W2, W3	Harness Assembly, Ribbon, Battery Interface-to-Contact Plate, Digital	80777-002	2
19		Label, Battery Charging	404968-001	1
20		LED Holder/Lens, T1	405121-001	1
21		Handle, Front	402026-001	1
22	W8	Harness, Battery Charging LED	405095-001	1
23		Screw, PNH, Phillips, SST, 4-40 x 7/8	4502-428	2
24		Basket Mount	407021-001	1
25		Spacer, Basket Mount	407022-001	2
26		Mounting Plate	405592-001	2
27		Bracket Extrusion	405591-002	2
28		Screw, BDGH, Phillips, 6-32 x 1-1/4	4502-640	4
29		Screw, 100FLH, 6-32 x 5/16	4505-610	4
31		Washer, Split Ring, No. 6	4520-106	4

[1]See Chapter 11, “Contact Plate Assembly,” for details
[2]See Chapter 13, “Battery Interface PCB,” for details

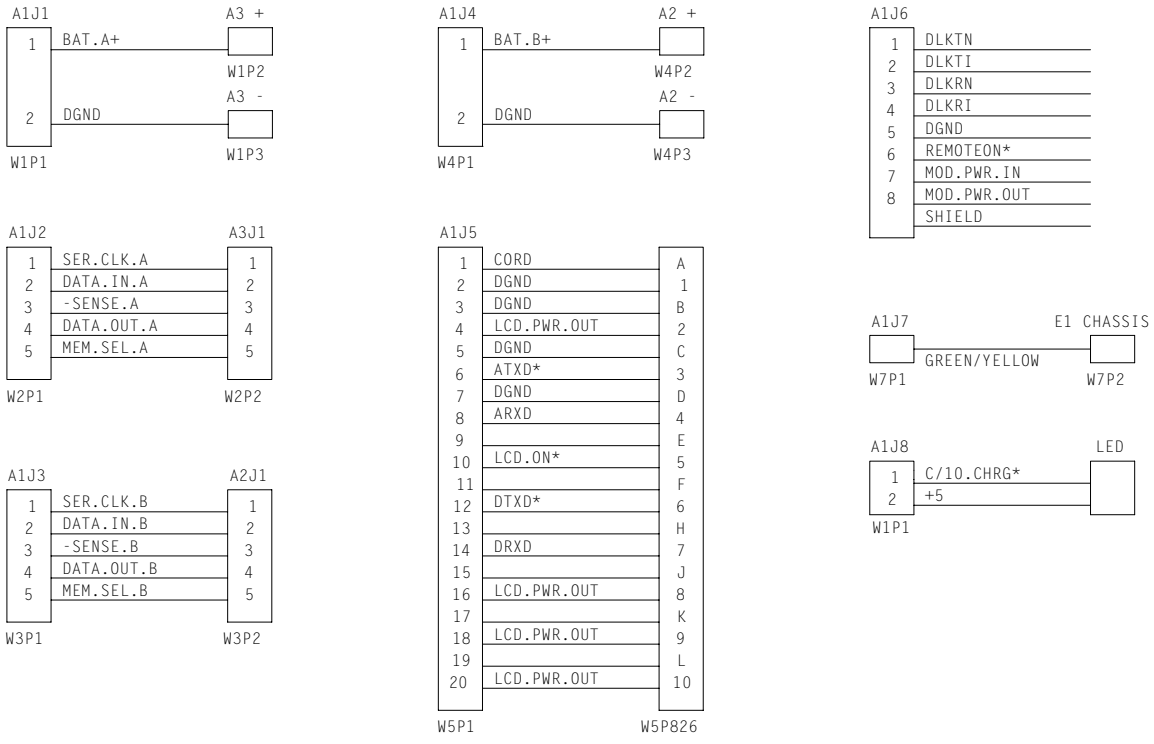
Exploded View 402472-001K



Interconnection Diagram 402472-001K



LEAD IDENT	ITEM NO.	COLOR	FROM CIRCUIT POINT	TO CIRCUIT POINT
W1	4	RED ,BLACK	BAT A + & -	J1
W2	18	RIBBON	J1	J2
W3	18	RIBBON	J1	J3
W4	4	RED ,BLACK	BAT B + & -	J4
W5	6	RIBBON	J5	-
W7	17	GRN/YELL	J7	E1



11 Contact Plate Assembly PN403191

WHAT IS IN THIS CHAPTER?

This chapter contains information about the contact plate assembly in the battery backpack assembly. Each battery backpack assembly contains two contact plate assemblies. They are used to route signals between the Smart-pac Battery Packs and/or Smart-pac Power Supply and the battery interface PCB.

This chapter includes a parts list, and an exploded view for the contact plate assembly.

The contact plate assembly is a part of the battery backpack assembly. For more information about that assembly, refer to Chapter 10, “Battery Backpack Assembly.”

Contents

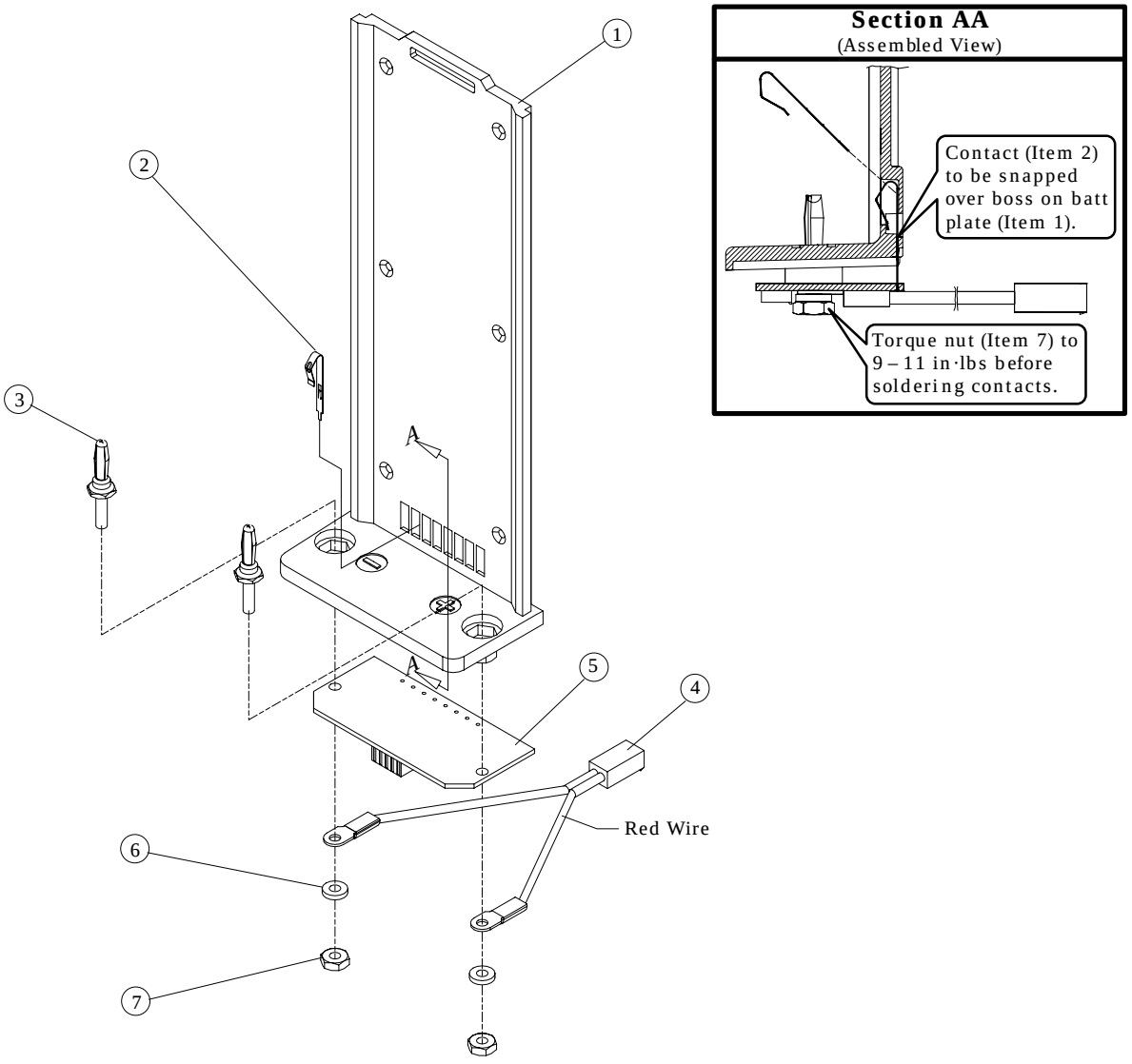
Parts List (PN 403191-001F) 11-2
Exploded View (PN 403191-001F) 11-2

Parts List 403191-001F

Item	Reference Designation	Description	Part Number	Qty
1		Contact Plate	401957-001	1
2		Contact, Battery, Digital	405157-002	8
3		Connector, Banana Jack, 0.175-inch Dia	402091-001	2
4		Harness Assembly, Battery Power	402537-001	1
5		Contact Plate PCB[1]	402708-002	1
6		Washer, Flat, SST, No 6	4520-006	2
7		Nut, Keps, Hex, 6-32	4521-706	2

[1]See Chapter 12, “Contact Plate PCB,” for details

Exploded View 403191-001F



12 Contact Plate PCB PN402708

WHAT IS IN THIS CHAPTER?

This chapter contains information about the contact plate PCB. The contact plate PCB acts as a path for the power to and from the Smart-pac battery pack or Smart-pac power supply. It contains no active electronic devices — only connectors.

This chapter provides a parts list, parts location diagram, and schematic diagram for the contact plate PCB.

A contact plate PCB is located in each of the two contact plate assemblies in a battery backpack assembly. For more information about the contact plate assembly, refer to Chapter 11, “Contact Plate Assembly.”

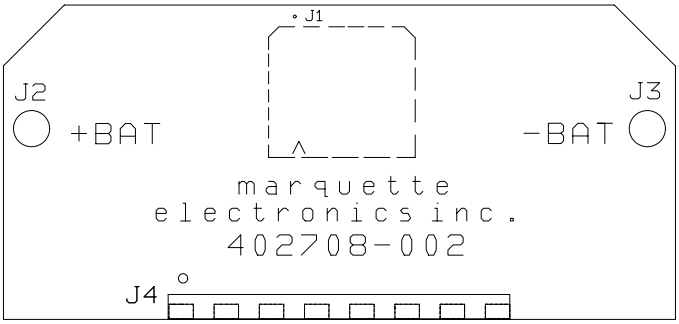
Contents

Parts List (PN 402708-002D) 12-2
Parts Location Diagram (PN 402708-002D) 12-2
Schematic Diagram (PN 402708-002D) 12-2

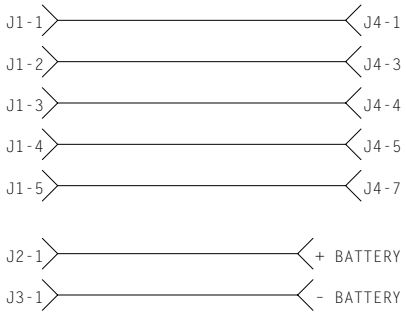
Parts List 402708-002D

Reference Designation	Description	Part Number	Qty
J1	Connector, PC Header, 5-Pin	17043-005	1
–	Circuit Board	402708-001D	1

Parts Location Diagram 402708-002D



Schematic Diagram 402708-002D



13 Battery Interface PCB PN 403861

WHAT IS IN THIS CHAPTER?

This chapter contains information about the battery interface PCB. This assembly:

- routes signals between the transport display assembly and Tram module,
- supplies power from the Smart-pac battery packs or Smart-pac power supply to the transport display assembly and the Tram module,
- provides battery status information to the transport display assembly; and
- controls charging of a Smart-pac battery pack when a Smart-pac power supply is also installed on the battery backpack assembly.

The battery interface PCB is the only circuit board in the battery backpack assembly that contains active electronic components.

This chapter lists the parts that make up this assembly and provides parts location and schematic diagrams.

The battery interface PCB is a part of the battery backpack assembly. For more information about that assembly, refer to Chapter 10, “Battery Backpack Assembly.”

Contents

Parts List (PN 403861-002G) 13-2
Parts Location Diagram (PN 403861-002G) 13-4
Schematic Diagram (PN 403861-003E) 13-5

Parts List 403861-002G

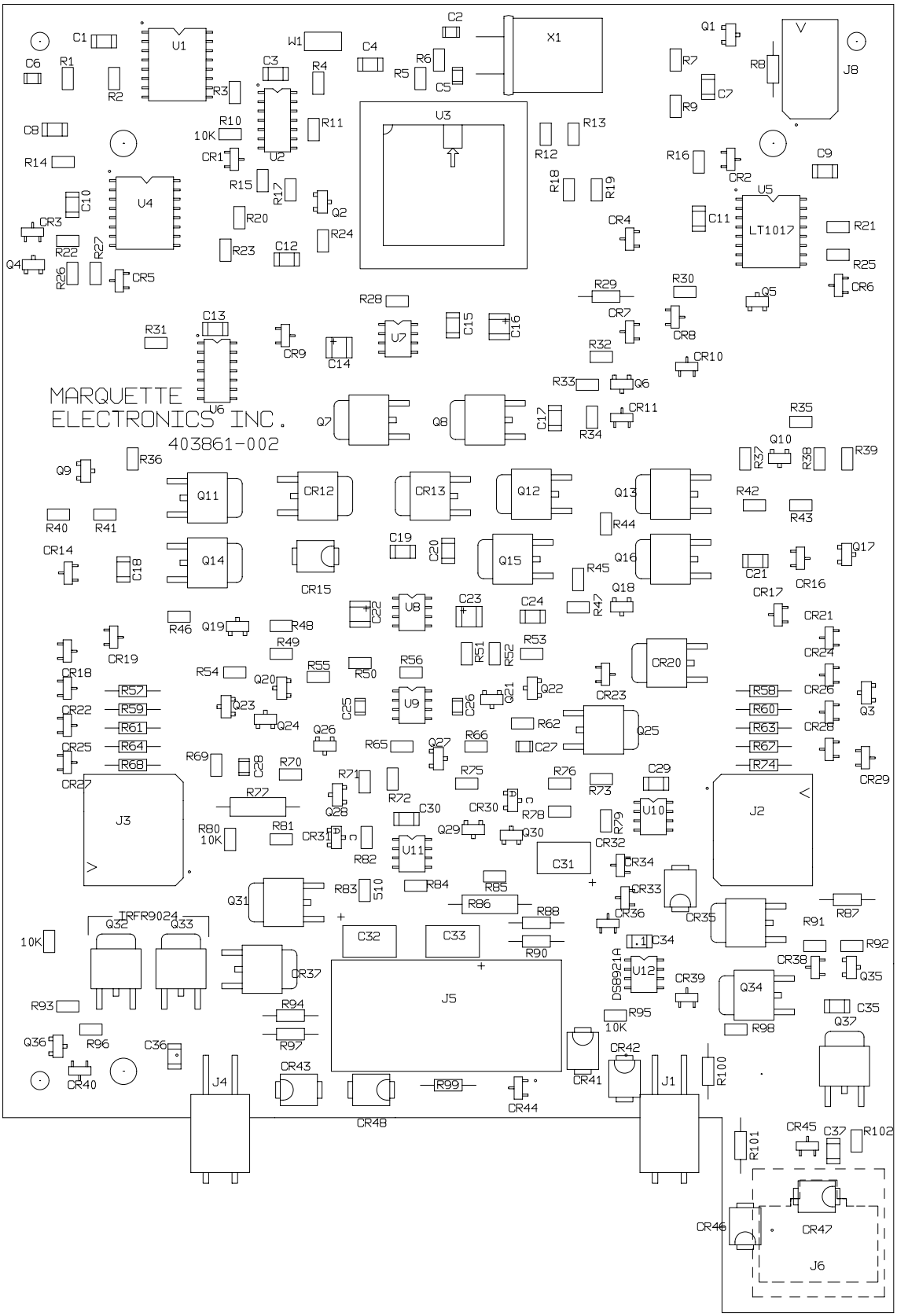
Reference Designation	Description	Part Number	Qty
C1, 3, 4, 7 – 13, 15, 17 – 21, 24, 29, 30, 34 – 37	Cap, Cer, 0.1µF, +80/–20%, 50V	404370-001	23
C2, 5	Cap, Cer, 27pF, 5%, 50V, SM	1181-270	2
C6	Cap, Cer, 820pF, 5%, 50V, SM	1181-821	1
C14, 16, 22, 23	Diode, Schottky, SM MBRD340	403929-001	5
C25 – 28	Cap, Cer, 0.01µF, 5%, 50V, SM	1182-103	4
C31	Cap, Tant, 10µF, 20%, 25V, SM	1152-106	1
C32, 33	Cap, Tant, 10µF, 20%, 25V, SM	1152-106	2
CR1 – 11, 14, 16 – 19, 21 – 29, 32, 34, 36, 38, 39, 40, 44, 45	Diode Pair, Series, SM D7000	2013-201	33
CR12, 13, 20, 25, 37	Diode, Schottky, Barrier, 1A, 40V, SM MBRS140T3	403187-001	1
CR15	Diode, Schottky, Rectifier, SM MBRD340	403929-001	5
CR30, 31	Diode, Zener, 4V, SM BZX84C6V8	403937-003	1
CR33, 41	Transorb, Bidirectional, 10V, 600W, SM SM6T10CA	404286-001	2
J1, 4	Connector, Header, 2-Pin, w/Locks	1850-002	2
J2, 3	Connector, PC Header, 5-Pin	17043-005	2
J5	Cable Assembly, Ribbon, 20-Pin	402535-001	1
J6	Connector, Receptacle, 8-Pin, Vertical	17023-001	1
J8	Connector, PC Header, 2-Pin	17043-002	1
Q1, 2, 4, 5, 17 – 23, 26, 27, 28, 30, 35, 36	Transistor, NPN, SM T3904	2511-001	17
Q3, 6, 9, 10	Transistor, NPN, SM T6428	404304-001	4
Q7, 8, 11 – 16, 32, 33, 34, 37	Transistor, MOSFET, P-Channel, SM IRFR9024	403274-001	12
Q24, 29	Transistor, PNP, SM T3906	2511-101	2
Q25, 31	Transistor, PNP, SM MJD2955	403930-001	2
R1	Res, Cer, 499K, 1%, 1/8W, SM	1082-499	1
R2	Res, Cer, 200K, 1%, 1/8W, SM	1082-200	1
R3, 4, 10, 11, 18, 79, 95, 98	Res, Cer, 10K, 5%, 1/8W, SM	1081-103	8
R5, 12	Res, Cer, 51K, 5%, 1/8W, SM	1081-479	2
R6	Res, Cer, 10M, 5%, 1/8W, SM	1081-106	1
R7	Res, Cer, 909K, 1%, 1/8W, SM	1082-820	1
R8	Res, Comp, 510Ω, 5%, 1/8W	1000-511	1
R9, 34, 42, 46, 47, 91, 93	Res, Cer, 100K, 1%, 1/8W, SM	1082-100	7
R13, 17, 19, 24, 28, 30 – 33, 39, 41, 43, 44, 45, 48, 49, 50, 52, 53, 66, 73, 80, 84, 85, 89, 92, 96, 102	Res, Cer, 10K, 1%, 1/8W, SM	1082-104	28

→

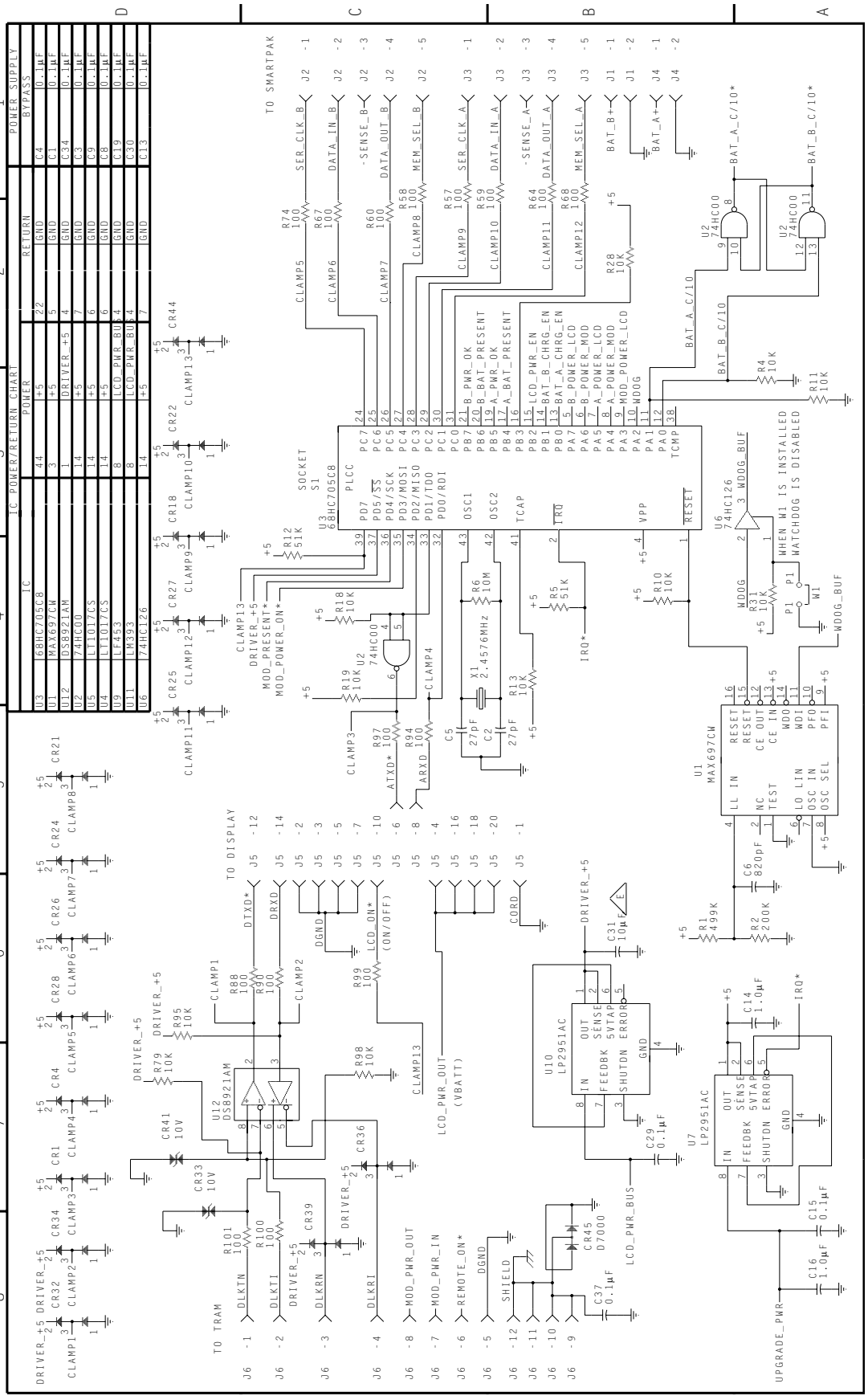
→ Parts List 403861-002G

Reference Designation	Description	Part Number	Qty
R14, 16	Res, Cer, 63.4K, 1%, 1/8W, SM	1082-808	2
R15, 56, 62, 69, 70, 76, 81	Res, Cer, 1K, 1%, 1/8W, SM	1082-103	7
R20	Res, Cer, 20K, 1%, 1/8W, SM	1082-202	1
R21, 27	Res, Cer, 1.5M, 1%, 1/8W, SM	1082-819	2
R22, 35	Res, Cer, 1.02M, 1%, 1/8W	1082-775	2
R23	Res, Cer, 51.1K, 1%, 1/8W, SM	1082-772	1
R25, 26	Res, Cer, 6.34K, 1%, 1/8W, SM	1082-822	2
R29	Res, Comp, 10Ω, 5%, 1/8W	1000-100	1
R36, 38	Res, Cer, 121K, 1%, 1/8W, SM	1082-753	2
R37, 40	Res, Cer, 150Ω, 1%, 1/8W, SM	1082-767	2
R51, 54	Res, Cer, 4.75K, 1%, 1/8W, SM	1082-760	2
R55, 75	Res, Cer, 2.21K, 1%, 1/8W, SM	1082-787	2
R57 – 61, 63, 64, 67, 68, 74, 88, 90, 94, 97, 99, 100, 101	Res, Comp, 100Ω, 5%, 1/8W	1000-101	17
R65, 71	Res, Cer, 107K, 1%, 1/8W, SM	1082-817	2
R72, 82	Res, Cer, 53.6K, 1%, 1/8W, SM	1082-818	2
R77, 86	Res, WW, 0.5Ω, 5%, 1/2W	1017-005	2
R78, 83	Res, Cer, 510Ω, 5%, 1/8W, SM	1081-476	2
R87	Res, Comp, 200Ω, 5%, 1/8W	1000-201	1
U1	Microprocessor Supervisory Circuit, SM MAX697	403894-001	1
U2	NAND Gate, 2-Input, Quad , SM HC00	3038-000	1
U3	Microcontroller, Programmed 68HC705C8	404424-002	1
U4, 5	Amplifier, SM LT1017	404283-001	2
U6	Decoder, 2-Line-to-4-Line, Dual/Demultiplexer, 1-Line-to-4-Line, Dual, SM HC126	403033-001	1
U7, 8, 10	Volt Rgltr, Adj, SM LP2951A	3076-001	3
U9	Amplifier, SM LF453	402094-001	1
U11	Volt Comparator, Dual LM393	3144-393	1
U12	Driver/Receiver, RS422, SM DS8921AM	404013-001	1
W1	Socket	1818-201	2
X1	Crystal, 2.4576MHz, HC18	400409-001	1
–	Socket, PLCC, 44–Pin (for U3)	17042-002	1
–	Circuit Board	403861-001D	1
–	Schematic Diagram	403861-003E	REF

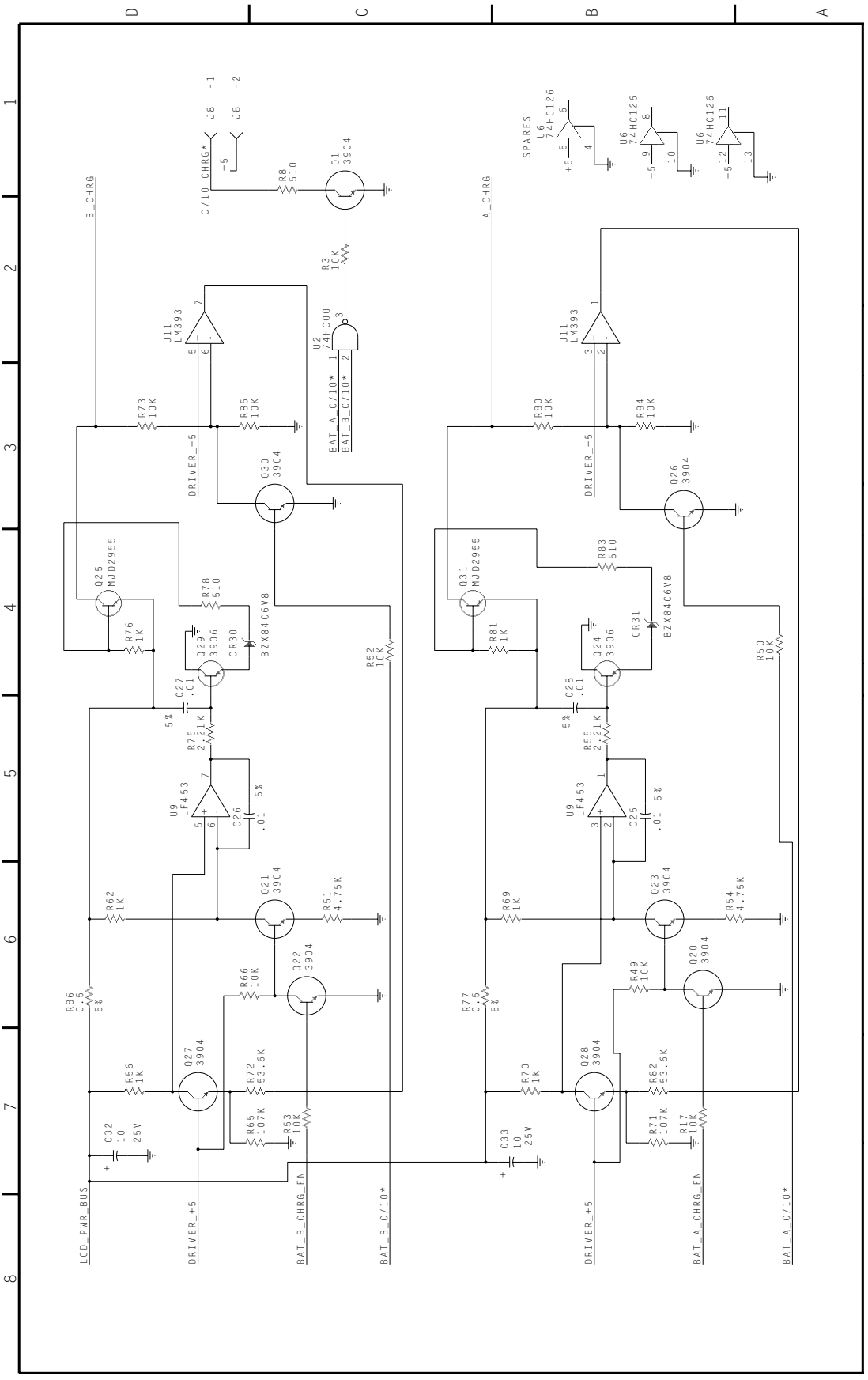
Parts Location Diagram 403861-002G



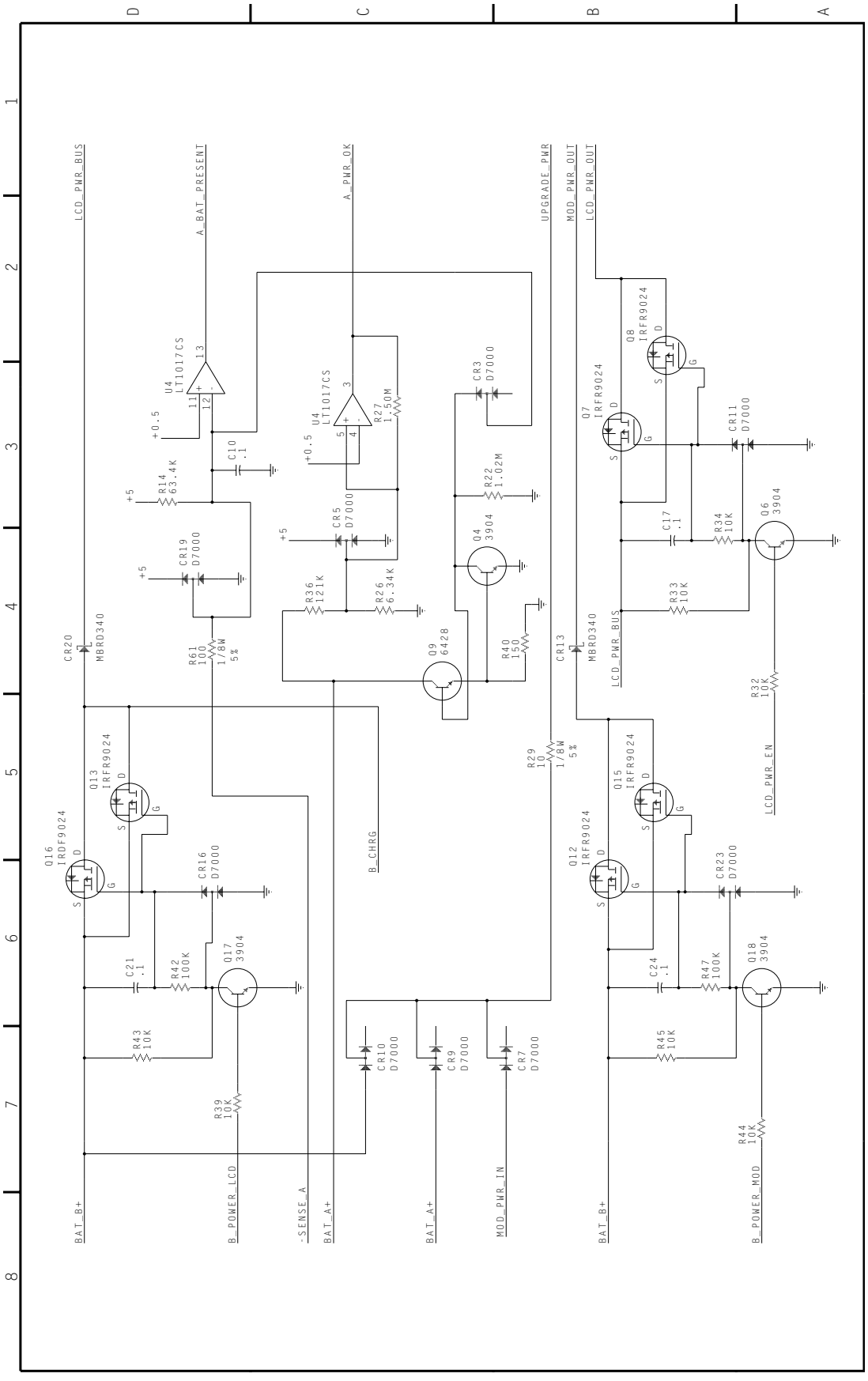
Schematic Diagram (Sheet 1 of 5) 403861-003E



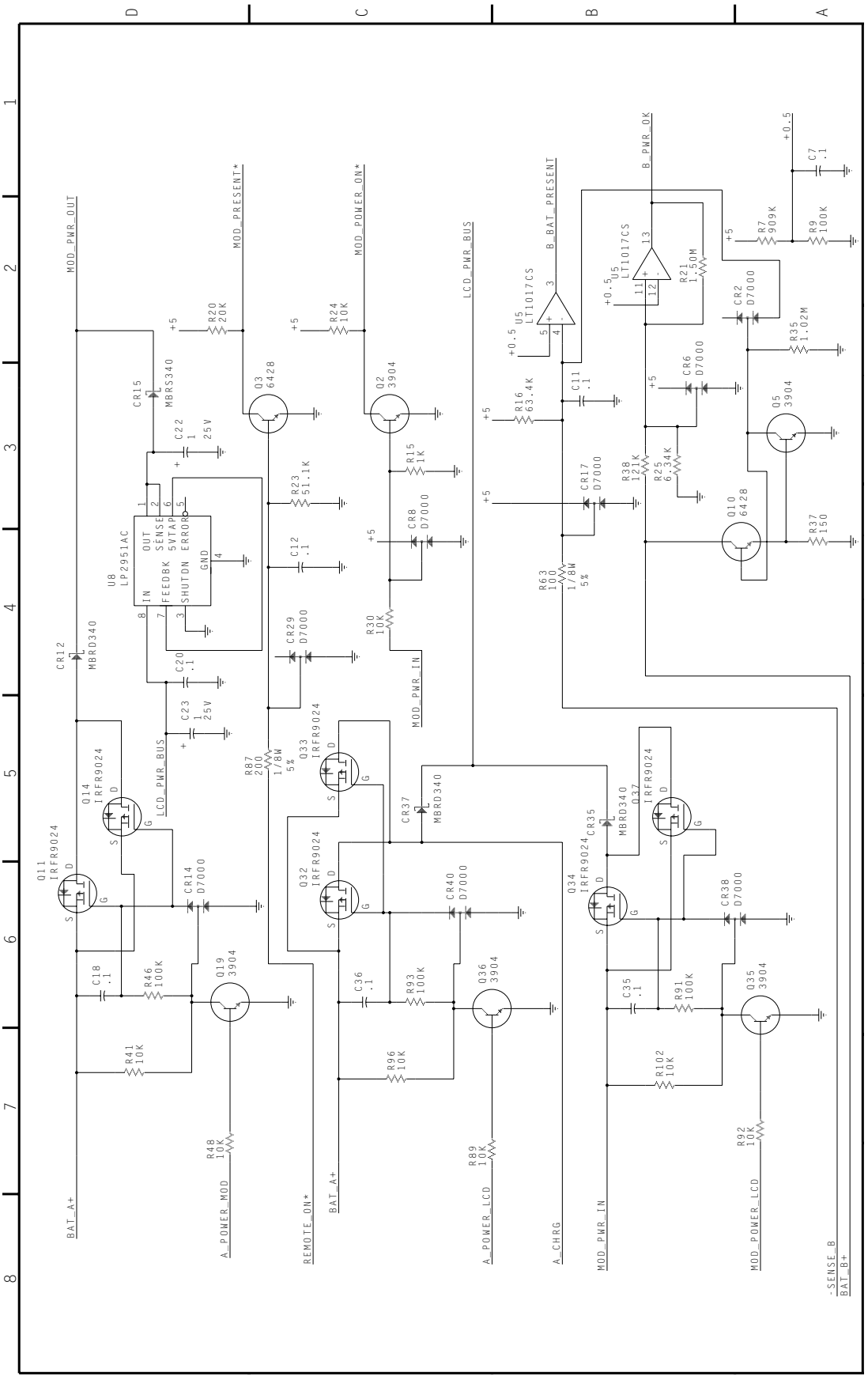
Schematic Diagram (Sheet 2 of 5) 403861-003E



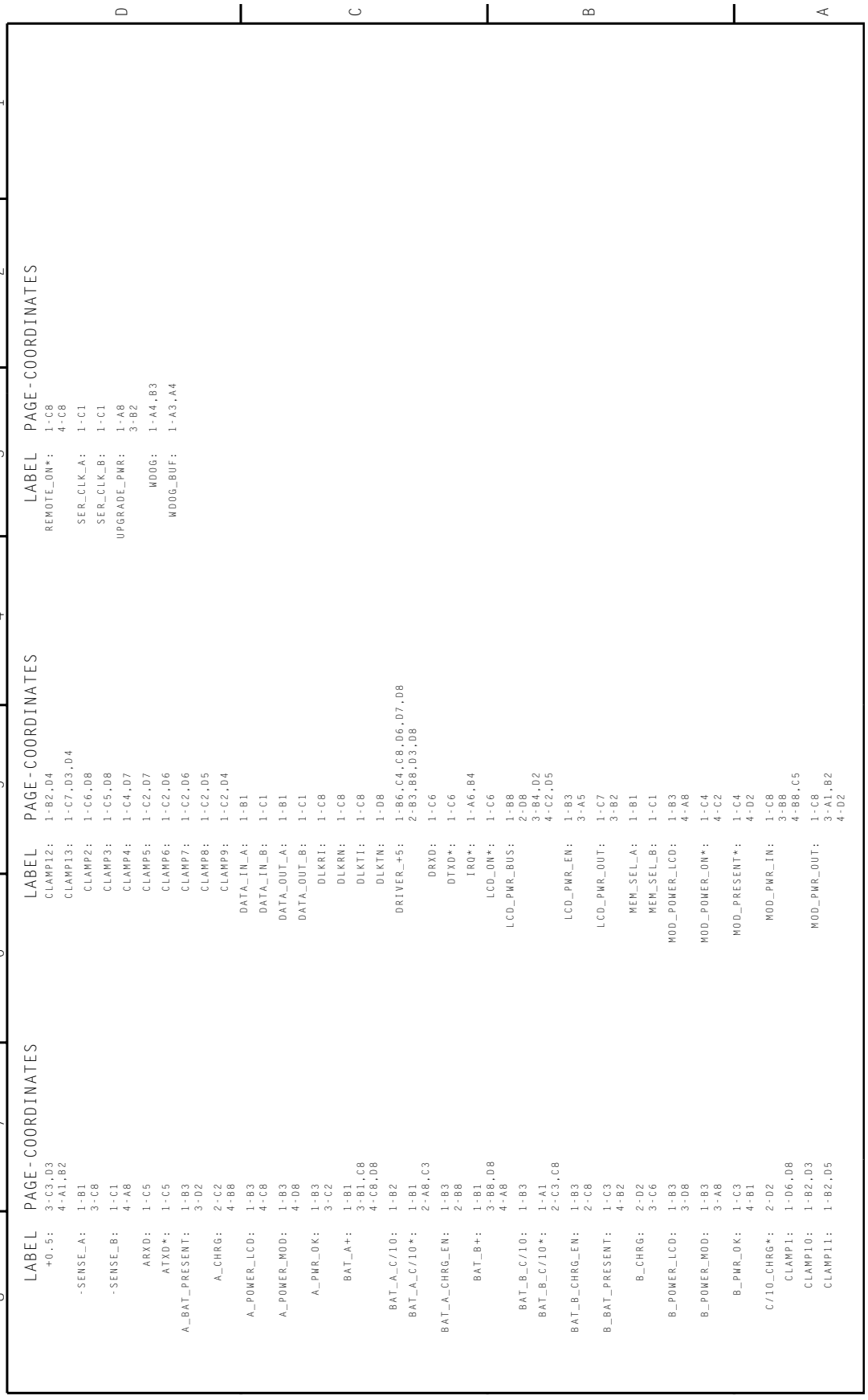
Schematic Diagram (Sheet 3 of 5) 403861-003E



Schematic Diagram (Sheet 4 of 5) 403861-003E



Schematic Diagram (Sheet 5 of 5) 403861-003E



LABEL	PAGE-COORDINATES
+0.5:	3-C3,D3
	4-A1,B2
-SENSE_A:	1-B1
	3-C8
-SENSE_B:	1-C1
	4-A8
ARXD:	1-C5
ATXD*:	1-C5
A_BAT_PRESENT:	1-B3
	3-D2
A_CHRG:	2-C2
	4-B8
A_POWER_LCD:	1-B3
	4-C8
A_POWER_MOD:	1-B3
	4-D8
A_PWR_OK:	1-B3
	3-C2
BAT_A+:	1-B1
	3-B1,C8
	4-C8,D8
BAT_A_C/IO:	1-B2
BAT_A_C/IO*:	1-B1
	2-A8,C3
BAT_A_CHRG_EN:	1-B3
	2-B8
BAT_B+:	1-B1
	3-B8,D8
	4-A8
BAT_B_C/IO:	1-B3
BAT_B_C/IO*:	1-A1
	2-C3,C8
BAT_B_CHRG_EN:	1-B3
	2-C8
B_BAT_PRESENT:	1-C3
	4-B2
B_CHRG:	2-D2
	3-C6
B_POWER_LCD:	1-B3
	3-D8
B_POWER_MOD:	1-B3
	3-A8
B_PWR_OK:	1-C3
	4-B1
C/IO_CHRG*:	2-D2
CLAMP1:	1-D6,D8
CLAMP10:	1-B2,D3
CLAMP11:	1-B2,D5
CLAMP12:	1-B2,D4
CLAMP13:	1-C7,D3,D4
CLAMP2:	1-C6,D8
CLAMP3:	1-C5,D8
CLAMP4:	1-C4,D7
CLAMP5:	1-C2,D7
CLAMP6:	1-C2,D6
CLAMP7:	1-C2,D6
CLAMP8:	1-C2,D5
CLAMP9:	1-C2,D4
DATA_IN_A:	1-B1
DATA_IN_B:	1-C1
DATA_OUT_A:	1-B1
DATA_OUT_B:	1-C1
DLKRI:	1-C8
DLKRN:	1-C8
DLKTI:	1-C8
DLKTN:	1-D8
DRIVER_+5:	1-B6,C4,C8,D6,D7,D8
	2-B3,B8,D3,D8
DRXD:	1-C6
DTXD*:	1-C6
IRQ*:	1-A6,B4
LCD_ON*:	1-C6
LCD_PWR_BUS:	1-B8
	2-D8
	3-B4,D2
	4-C2,D5
LCD_PWR_EN:	1-B3
	3-A5
LCD_PWR_OUT:	1-C7
	3-B2
MEM_SEL_A:	1-B1
MEM_SEL_B:	1-C1
MOD_POWER_LCD:	1-B3
	4-A8
MOD_POWER_ON*:	1-C4
	4-C2
MOD_PRESENT*:	1-C4
	4-D2
MOD_PWR_IN:	1-C8
	3-B8
	4-B8,C5
MOD_PWR_OUT:	1-C8
	3-A1,B2
	4-D2
REMOTE_ON*:	1-C8
	4-C8
SER_CLK_A:	1-C1
SER_CLK_B:	1-C1
UPGRADE_PWR:	1-A8
	3-B2
WDOG:	1-A4,B3
WDOG_BUF:	1-A3,A4

For your notes